

Wood Mackenzie

“Western Australia Gas Market Study”

Final Report

26th March 2010

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The information upon which this report is based comes from our own experience, knowledge and databases. The opinions expressed in this report are those of Wood Mackenzie. They have been arrived at following careful consideration and enquiry but we do not guarantee their fairness, completeness or accuracy. The opinions, as of this date, are subject to change. We do not accept any liability for your reliance upon them.

Table of Contents

List of Figures	5
List of Tables	5
Glossary	6
Section 1: Study Objectives	7
Section 2: Executive Summary	8
Section 3: Number of Customers and Their Requirements	12
Section 4: Number of Suppliers and Available Reserves	19
Section 5: Gas Transportation Options	34
Section 6: Gas Storage Options	39
Section 7: Activities of Gas Brokers / Aggregators	40
Section 8: Existence of Gas Related Financial Markets	42
Section 9: Existence of Short Term and Spot Market Sales	43
Section 10: Identify Changes in the WA Gas Market	44
Section 11: Likely Future Market Development	45
Appendix 1 - Carnarvon Basin Retention Leases	49
Appendix 2 - 2009 LNG Projects – Australia & PNG	50
Appendix 3 – Carnarvon, Browse and Perth Basin Gas Resources	51

List of Figures

FIGURE 1	WA GAS CUSTOMERS 1998 - 2009 (TJ/D).....	13
FIGURE 2	WA GAS BUYERS 1998 & 2009.....	13
FIGURE 3	WA GAS MARKET LOCATIONS AND MAKE UP.....	15
FIGURE 4	WA ALUMINA PLANT OWNERSHIP AND GAS DEMAND.....	16
FIGURE 5	WA GAS SALES BY FIELDS 1998 - 2009 (TJ/D).....	20
FIGURE 6	WA GAS SELLERS/PRODUCTION FACILITIES 1998 - 2009 (TJ/D).....	20
FIGURE 7	WA GAS SELLERS 1998 AND 2009.....	21
FIGURE 8	WA GAS MARKET SHARE BY JOINT VENTURE 2009.....	22
FIGURE 9	CARNARVON AND PERTH BASINS WITH MAJOR WA GAS SUPPLY FIELDS.....	23
FIGURE 10	WA GAS FIELDS COMMERCIAL AND TECHNICAL RESERVES (> 2,000 PJ).....	24
FIGURE 11	WA GAS FIELDS COMMERCIAL AND TECHNICAL RESERVES (< 2,000 PJ ; > 200 PJ).....	24
FIGURE 12	WA GAS FIELDS REMAINING COMMERCIAL AND TECHNICAL RESERVES (< 200 PJ).....	25
FIGURE 13	WA CARNARVON BASIN CONTRACTED AND UNCONTRACTED.....	26
FIGURE 14	WA CARNARVON BASIN GAS RESERVES OWNERSHIP (BY PERCENTAGE).....	27
FIGURE 15	WA CARNARVON BASIN GAS RESERVES BY OPERATOR.....	27
FIGURE 16	OWNERSHIP OF WA GAS RESERVES (BY VOLUME).....	28
FIGURE 17	OPERATORS OF WA GAS RESERVES (BY VOLUME).....	28
FIGURE 18	BROWSE BASIN MAJOR FIELDS AND PROPOSED GREAT NORTHERN PIPELINE.....	30
FIGURE 19	WA GAS TRANSMISSION LINES.....	34
FIGURE 20	DAMPIER TO BUNBURY PIPELINE CAPACITY 1998 – 2011 EST.....	36
FIGURE 21	GASTRADING WEBSITE.....	41
FIGURE 22	BROWSE BASIN GAS FIELDS AND PROPOSED GREAT NORTHERN PIPELINE.....	47

List of Tables

TABLE 1	MAJOR BUYERS OF WA DOMESTIC GAS	14
TABLE 2	1998 WA GAS RESERVES (PJ)	19
TABLE 3	JOINT VENTURE OWNERSHIP AND PERCENTAGE OF WA MARKET SALES	21
TABLE 4	CARNARVON BASIN NUMBER OF GAS FIELDS AND AVAILABLE VOLUMES	26
TABLE 5	WA MIDSTREAM GAS PROCESSING INFRASTRUCTURE	29
TABLE 6	RECENT WA GAS TRANSMISSION EXPANSIONS	35
TABLE 7	AVAILABLE WA GAS TRANSMISSION CAPACITY	36

Glossary

ACCC	means Australian Consumer and Competition Commission
APA	means APA Group comprised of Australian Pipeline Trust and APT Investment Trust
CCGT	means Combined Cycle Gas Turbine
DBP	means DBNGP (WA) Transmission Pty Ltd.
DBNGP	means Dampier to Bunbury Natural Gas Pipeline
Domgas	means domestic gas
ERA	means Economic Regulatory Authority
FEED	means Front-end Engineering and Design
FID	means Final Investment Decision
FPSO	means Floating Production, Storage and Offloading
Gas	means dry natural gas of pipeline quality produced from gas reservoirs
GFC	means Global Financial Crisis
GSA	means Gas Sales Agreement
GGT	means Goldfields Gas Transmission Pipeline
GJ	means Gigajoules
GJ/d	means Gigajoules per day
IMO	means Independent Market Operator
mmbtu	means million British Thermal Units
MTPA	means Million Tonnes (metric) per annum
LNG	means liquefied natural gas
MW	means Megawatt
NWSP	means North West Shelf gas production Project
OCGT	means open cycle gas turbine
PJ	means Petajoules
PJ/a	means Petajoules per annum
PPS	means Pilbara Pipeline System
SECWA	means State Energy Commission of Western Australia
SWIS	means South West Interconnected System
Tcf	means Trillion cubic feet
TJ	means Terajoules
TJ/d	means Terajoules per day
WA	means Western Australia

Section 1: Study Objectives

North West Shelf Project (NWSP) are seeking to examine the structure of and competitive conditions in the Western Australian natural gas market. NWSP have asked Wood Mackenzie to examine matters of particular relevance in the detail market feature considerations reported on by the ACCC in their 29 July, 1998 determination. The specific areas of examination by the ACCC in this original assessment are covered, and where appropriate relative comments made as to the general evolution of the WA gas market since the ACCC examination. Where appropriate comments have been made in the report with relevance to the feasibility of separate marketing of natural gas in WA. In particular the following key areas are addressed in this report.

- Number of customers and their requirements;**
- Number of competitive suppliers and their available reserves;**
- Gas transportation options;**
- Gas storage options;**
- Activities of gas brokers / aggregators;**
- Existence of gas-related financial markets;**
- Extent of short term and spot markets / sales:**
- Identify or set out the extent of any change in the Western Australian gas market from 1998 to the present and Wood Mackenzie's conclusions regarding any changes in the maturity / liquidity of the market;**
- Where possible forecasts of any likely future material market developments;**
- Other features of the Western Australian natural gas industry in addition to those listed above that Wood Mackenzie believe should be included in the report, which are relevant to the general assessment of the competitiveness of the WA gas market**

Section 2: Executive Summary

On July 29, 1998 the ACCC provided a determination¹ to the NWSP allowing the joint marketing of gas to the domestic gas market of Western Australia, under a number of provisions and conditions related to the extent and duration of this determination. This determination commented that separate marketing was preferred for gas supply contracting where possible, however, the determination outlined a number of market features which were needed to allow separate marketing to be viable. The features identified included the existence of; trading, swapping, and hedging arrangements, a number of competitive suppliers, the existence of aggregators and brokers, and gas storage facilities. The ACCC concluded that few (if any) of these features currently existed in the WA gas market, likely causing separate marketing to remain infeasible. The determination went on to state:

“While it is impossible to be prescriptive about exactly what market features need to develop before separate marketing will become viable in WA, the greater the number of the following list of market developments that are introduced, the greater the likelihood that separate marketing will be viable:

- *A significant increase in the number of customers;*
- *The entry of new competitive suppliers;*
- *Additional transportation options;*
- *Storage;*
- *The entry of brokers / aggregators;*
- *The creation of gas-related financial markets; and*
- *The development of significant short term and spot markets”²*

Wood Mackenzie’s assessment assesses the change in these identified key criteria in the WA gas market from 1998 to present. In summary, we make the following observations:

Overview comments on changes in the feasibility of separate marketing of natural gas in WA:

The WA domestic gas market has grown by over 50% from 1998 levels by volume (to 2007), however, by most measures outlined in the ACCC 1998 determination has not materially changed. Buyers and Sellers remain concentrated and pipeline capacity remains fully contracted and no gas related financial markets exist. The major sellers of gas are proportionately unchanged. Notably the NWSP gas sales have increased from an estimated 467 TJ/d average in 1998 to current levels of 572 TJ/d, however, proportionately they are the same as in 1998. Buyers remained fairly concentrated, however, the number of buyers outside of the top four buyers has increased from 14% to 28% of the market (although one new entrant has accounted for most of this increase). Accommodation of short term and spot transaction has been frustrated by lack of supply and pipeline capacity, however, efforts such as the DBP’s Inlet Trades system has facilitated exchanges and gas balancing which did not exist in 1998. There has been advancement in some areas such as the emergence of short term trading, aggregation and minor spot sales. Overall, the WA gas market is still immature but is evolving.

Change in the number of customers;

Wood Mackenzie estimates volumetrically gas throughput in the WA domestic gas market has increased from approximately 640 TJ/d in 1998 to 865 TJ/d (estimate) in 2009. The WA domestic gas market is characterised by four primary gas buyers, however, their overall share of the WA gas market has decreased materially from 86% in 1998 to estimated 72% for 2009. Other buyers outside of the big four have doubled from 14% of all domestic gas purchased to a current estimate of 28% for 2009, although this has predominantly been driven by the development of one substantial new industrial buyer – Burrup Fertilisers. The total number of active Gas Sales Agreements (GSA’s) to the WA domestic gas market have increased from an estimated 22 in 1998, to a peak of 33 in 2005, to 26 contracts currently active in

¹ ACCC, “*Determination – Application for Authorisation North West Shelf Project*”, 29 July, 1998.

² ACCC, “*Determination – Application for Authorisation North West Shelf Project*”, 29 July, 1998. p49.

2009. The decline in contract numbers from 2005 was attributable to a number of small volume contracts terminating. Overall volumes peaked at approximately 1000 TJ/d in 2007, then declined in 2008 due initially to the Varanus Island gas plant explosion, and later to a modest extent due to demand destruction attributable to the Global Financial Crisis. Volumes for 2009 are an estimate but are showing recovery from 2008 levels.

The WA gas market is characterised by “lumpy” gas market growth compared to other markets where supply and demand growth is more “incremental”. It takes the alignment and coordination of all four supply chain elements to realize increased gas demand (gas supply, gas processing, gas transmission, and a gas market / end-users). The alignment of all of these elements results in a more difficult to co-ordinate, “lumpy” gas market growth.

The entry of new competitive suppliers;

Gas sales into the WA domestic gas market continue to be predominantly from the NWSP, Apache, and Santos. Gas sales from these suppliers in 1998 comprised 94% of all WA gas sales, and in 2009 are estimated to make up 95% of all sales.

The potential entry of new competitive gas suppliers into the WA gas market appears promising with a number of large gas fields having been discovered since 1998. However, as can be seen in Section 4 of this report, the majority of the known gas reserves in the Carnarvon Basin are now associated with existing or proposed LNG projects. LNG projects arguably provide the economies of scale required to most effectively monetize these large fields. Some of these fields may have associated or independent domestic gas components, however, no such plans are clear at this time (see Section 4).

Also in the Carnarvon Basin are a number of moderate size gas fields – defined as 200 – 2,000 PJ. Of these fields two currently hold promise for providing domestic gas supplies in the near to medium term; BHPBilliton/Apache’s Macedon field, and Apache/Santo’s Reindeer field. Both of these fields currently have initiatives underway to bring gas to the WA domestic market – Apache/Santos Reindeer is now committed and targeting 1st gas in 2011. BHPBilliton/Apache’s Macedon field has entered FEED study, but is not yet committed. Other hopeful gas fields for the domestic market include Halyard and Spar fields, each require access and capacity through Varanus Island processing facilities, which is not expected in the medium term. A number of other fields are under consideration for the LNG or domestic markets (a number of Hess fields). Apache/Kufpec recently announced they will develop their Julimar area gas fields as part of the Wheatstone LNG Project rather than a domestic gas project.

The remaining known Carnarvon Basin gas fields below 200 PJ are marginal commercially or too remote to justify independent gas connection and processing facilities.

In the longer term WA’s Domestic Gas Reservation directive should enable additional gas supplies to the WA domestic market. In concept this policy sets aside the equivalent volume of 15% of the gas exported for the domestic market. The actual provisions for domestic gas are negotiated as part of the State Agreement for each land based LNG project. The actual volume of domestic gas provided to the WA domestic market over time will hinge upon the realization of WA’s many proposed LNG projects which will each compete for market.

Constraint in gas processing points;

Part of the perceived “lumpiness” of the WA domestic market comes from the necessity and limitation of mid-stream gas processing facilities. The majority of gas produced into the WA domestic market over the past 10 years has come through two primary production points; NWSP domestic gas plant at Dampier, and Apache joint venture facilities on Varanus Island. These facilities are currently at or near capacity. For domestic gas volumes to increase additional gas processing capacity will be needed at these gas processing points or at new facilities such as Apache’s planned Devil Creek project, or BHPBilliton’s Macedon proposed processing facility. In June 2007, the NWSP abandoned efforts to upgrade their domestic gas supply capacity (targeted potential expansion of an extra 100 TJ/d through the de-bottlenecking of existing facilities) after experiencing difficulties and failure to achieve designed increases.

Additional transportation options;

Gas transportation options, as defined by number of gas pipeline alternatives, has not materially changed from 1998. WA gas transmission is still through the 4 primary pipelines that existed in 1998 – the DBP (previously DBNGP), the GGT, the Parmelia Pipeline, and the PPS (previously Pilbara Energy Pipeline).

Gas deliveries in WA, and overall pipeline capacities, have increased materially from 1998 yet meaningful surplus capacity is not available. The two primary gas transmission pipelines in WA – the DBP and the GGT – remain fully contracted.

Spare capacity does exist on the PPS and Parmelia pipeline systems, however, these systems are constrained by different fundamentals; the PPS having no incremental markets, and the Parmelia having very limited gas supply access (e.g from the dwindling Perth Basin, a DBP interconnect, and the fledgling Mondara storage facility).

Some new markets have been connected including the Burrup Fertilisers plant, mining projects Telfer, Nifty and Newcrest, as well as the town of Esperance through extension to the GGT.

Other progress has been made in the transmission sector with installation of an interconnection between the DBP and the GGT pipelines. This is a material step forward in allowing the GGT end-users access to the DBP supply sources, and conversely allowing DBP suppliers access to the GGT markets.

Storage;

Only a fledgling gas storage facility has become available since 1998, the Mondarra Gas Storage operated by APA Group. The gas storage site is situated at the north end of the Parmelia pipeline and is now interconnected with the DBP. The functionality of the Mondarra storage facility is currently understood to be only approximately 12-15 TJ/d injection and withdrawal. APA is currently seeking customers to underpin a Stage 1 enhancement of Mondarra to 35TJ/d inlet and 75TJ/d outlet capacity. Expansions beyond Stage 1 are possible, but will need to be underwritten by market contracts or project sponsors.

The entry of brokers / aggregators;

There is some modest evolution in the WA gas market brokering and aggregation services. Gas brokering, trading and aggregation may be as much as 10% of the DBP daily throughput³. Brokering and aggregations services are understood to be provided by four established parties (AlintaGas, Synergy, Verve Energy and Perth Energy), as well as two new gas trading start up businesses, and perhaps most materially via the DBP's "Inlet Trade" system which runs as a part of the DBP's Customer Reporting System. The DBP's Inlet Trades service enables DBP shippers to broker both gas supplies and transportation capacity, exchange imbalances and sell spot gas.

The creation of gas-related financial markets;

Wood Mackenzie is unaware of any gas related financial markets in existence in the WA gas market at this time. This is primarily due to the lack of material volume of transaction and counterparties to generate liquidity for traders. Spot gas sales or aggregations forums are not in any publicly accessible service as this time.

The development of significant short term and spot markets;

Short term and spot sales are understood to be occurring in WA as the result of several individual companies efforts, including "Inlet Trades" by the DBP pipeline to its customers which accommodates both gas supply and capacities needs and imbalance exchanges. Short term and spot sales transactions are not organized in any open readily accessible forum. The WA spot market is very modest and considered immature.

Other relevant comments include:

- **Little available gas supply:** There are currently no gas supplies which can be secured with certainty for the medium term. Some short term spot supplies are understood to be available, mainly due to modest GFC related demand destruction, but these volumes are small and expected to be short lived. Medium term hopeful gas supply projects are either nearly sold out, or do not yet have gas delivery date certainty:
 - Reindeer – Devil Creek (Apache / Santos) – Wood Mackenzie believes this to be nearly sold out
 - Macedon (BHPBilliton / Apache) – development and delivery date is uncertain
 - Pluto domgas – date of first gas uncertain
 - Gorgon domgas – date of first gas uncertain, possibly end 2015.
- **Disbanded gas trading Bulletin Board:** The IMO's Gas Bulletin Board (GBB) was established in response to the Varanus island disaster, experienced very little activity, and was discontinued on August 29, 2008.
- **Gas Sales Agreements and Gas Transportation Agreements:** In the WA gas market gas sales and transportation contracts are typically medium to long term, fixed volume Take or Pay arrangements.

³ Gorgon Determination. "Submission from DBP", 4 June 2009, p3

Summary of progress areas since 1998::

- A slightly more diversified customer base.
- Larger market through higher volumes being sold and transported.
- Standard pipeline access provisions are now in place.
- Multiple pipeline expansions have occurred and the DBP is committed to expand for loads of 10TJ/d or more.
- Trading, aggregation and spot sales activities have begun to emerge (although reported volumes are less than 10% of the total daily market demand and transactions lack transparency).
- Potential for substantial gas volumes to become available in the long term (primarily from the domestic gas component of LNG project developments).
- Some gas end-user failures have occurred - BHPBilliton's HBI plant, and Windamurra Vanadium plant - yet gas supplies to these projects have been absorbed by the market.

Section 3: Number of Customers and Their Requirements

In this section Wood Mackenzie has utilized our Upstream Service which captures WA market Gas Sales Agreements (GSA's) by seller (producer), and buyer. This analysis summarises gas buyers and off-take volumes in WA from 1998 to present highlighting the increase in total gas volumes contracted and the change in the number of transactions over this time.

Reference Point – WA domestic gas customer base 1998

Gas sales into the WA gas market in 1998 were identified in the ACCC 1998 Determination to include:

- Alcoa of Australia Ltd; *
- AlintaGas; *
- Western Power; *
- Hamersley Iron Pty Ltd; *
- Robe River Mining Co Pty Ltd; *
- Mission Energy Cogeneration
- BHP HBI

* Receiving disaggregated gas supply from the 1994 SECWA contract.

The ACCC determination advised that in 1998 there were 19 large gas purchasers⁴ and that further demand growth was expected in particular in the following areas:

- SouthWest – with the expansion of Alcoa and Worsley refineries, mineral sands processing, and the development of wood-pulp, paper and ammonia plants;
- Pilbara – a DRI (HBI) plant by AUSI Iron and other mineralogy and petrochemicals;
- Mid West iron and Steel Project (by then AFK – An Feng Kingstream) near Geraldton; and
- Goldfields – expected to increase in demand and in new customers.

The ACCC determination also highlighted contestability was being phased in since 1995 on gas sales, and was to be completed by 2000. Further, restrictions were to be placed on the sales of gas by downstream monopolies of AlintaGas and Western Power.

In summary the WA gas market of 1998 was characterised by a few major gas buyers but with the hope of significant growth and customer diversification in the near future.

Update - WA domestic gas customer base 2009

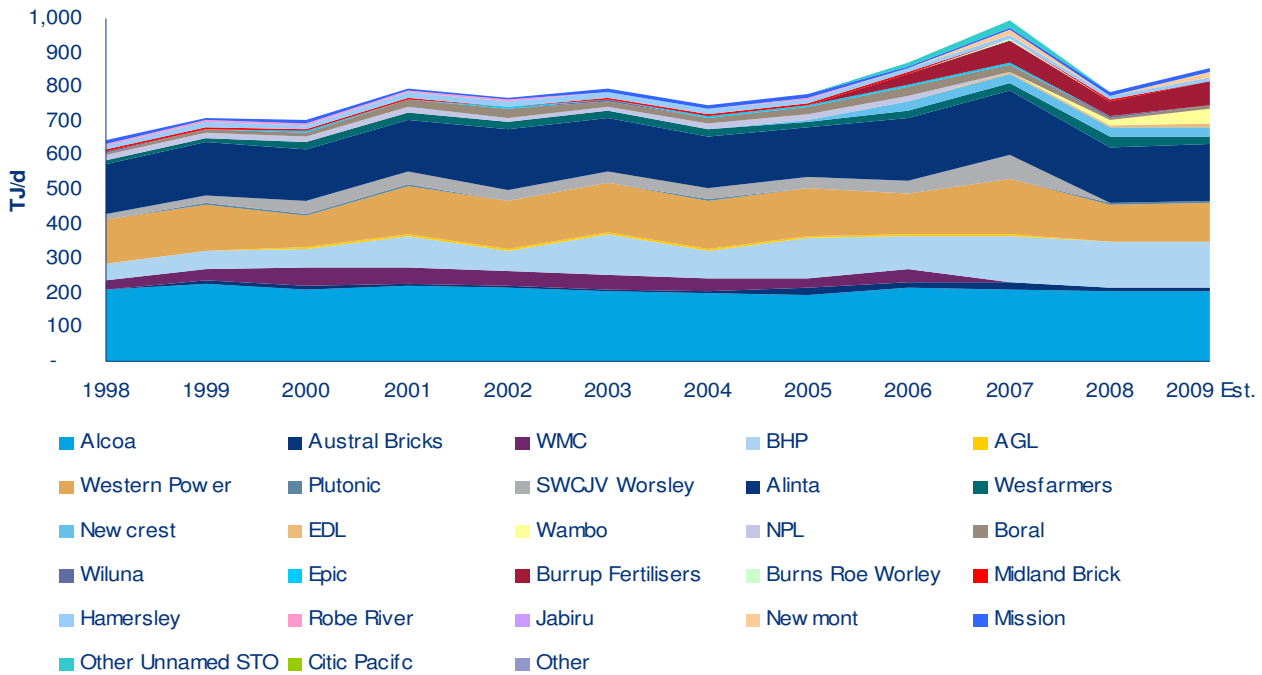
An examination of the WA domestic gas market today does indeed reveal significant growth. Gas sales to the West Australian market now average around 320 PJ/a and are the highest of any state in Australia. Domestic gas sales in WA have increased from approximately 640 TJ/d in 1998, reaching ~1000TJ/d in 2007. In 2008, however, the Varanus Island incident and the effects of the Global Financial Crisis resulted in a substantial fall in gas sales. Whilst the Varanus Island Gas plant was repaired in late 2008 and the Australian economy has recovered substantially during 2009, we have made a conservative estimate of approximately 865 TJ/d for 2009 gas sales.

From Wood Mackenzie's data bases, the number of GSA's to the WA gas market have increased over this period from 22 contracts in 1998 to a high of 33 active contracts in 2005, falling to 26 currently active contracts in 2009. Looking forward, much of the WA gas market will be de-contracting over the next decade as contracts expire although we expect these players to seek new contracted supply.

It should also be noted in the graphic below, the gas market in 2007 flowed approximately 1,000 TJ/d and was supplied by 27 GSA contracts. Average annual volumes retracted materially in 2008 mainly due to the Varanus incident. The following graphic highlights the growth over this period and also shows the continuance of the traditional buyers and the arrival of new buyers.

⁴ ACCC, "Determination – Application for Authorisation North West Shelf Project", 29 July, 1998. p16

Figure 1 WA Gas Customers 1998 - 2009 (TJ/d)



Source: Wood Mackenzie

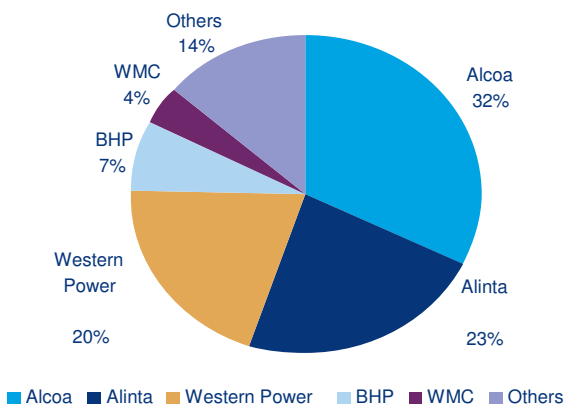
Gas sales by volume in WA have increased between 1998 and 2009, driven by the introduction of a few new gas buyers, as well as growth in some of the major customers. Gas demand increased by 56% between 1998 and 2007.

New markets: Over the past 10 years several new markets have begun taking gas including most significantly Burrup Fertilisers, Wambo Power, mining loads for Newcrest and Newmont, as well as gas supply for Wesfarmers and EDL mini-LNG facilities (in Kwinana and Maitland estate respectively), as well as gas supply for BRW's CNG operation to Exmouth.

An analysis of the market share of gas sales by buyer highlights the major buyers of gas in WA have changed little over this period. The following graphics highlights the major buyer proportions in both 1998 and 2009.

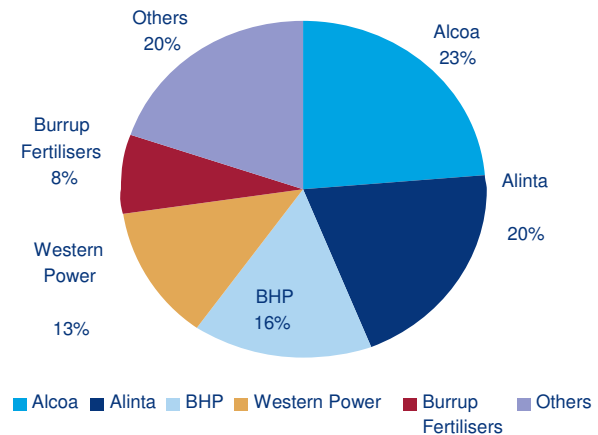
Figure 2 WA Gas Buyers 1998 & 2009

WA Gas Buyers 1998



Remarks :
 *Others - SWCJV Worsley, Hamersley, Westfarmers, Mission, Midland Brick, Boral, Austral Bricks, Robe River, Wiluna, Plutonic, AGL

WA Gas Buyers 2009



Remarks :
 *Others - Wambo, Newcrest, Wesfarmers, Newmont, Boral, Hamersley, Mission, Austral Bricks, EDL, Plutonic, AGL, Burns Roe Worley, Midland Brick, Jabiru

Source: Wood Mackenzie

From the above graphics it is clear that the majority of gas purchases in WA continue to be predominantly from four major buyers. The following table highlights the proportions of gas sales in WA by each of these major buyers. With the exception of BHP, market share of purchased gas in WA has decreased slightly for the major buyers as the overall volumes of gas sales to the market increase. Gas sales to domestic buyers outside of the top four have increased from 14% of all gas sales in 1998 to an estimated 28% in 2009. Burrup Fertilisers comprised 8% of the 2009 “Other” buyers. Excluding Burrup Fertilisers sees other buyers increasing from 14% of the WA market in 1998 to 20% on 2009.

Table 1 Major Buyers of WA Domestic Gas

Major WA Gas Buyers	Percentage of WA Market	
	1998	2009
Alcoa of Australia Ltd.	32%	23%
AlintaGas	23%	20%
Western Power Corp.	20%	13%
BHP (+WMC)	11%	16%
Burrup Fertilisers	0%	8%
Top 4 + Burrup Fertilisers	86%	80%
Other Buyers	14%	20%

Source: Wood Mackenzie

Lumpy nature of WA gas market growth

New gas demand in WA is characteristically “lumpy” due to the necessary simultaneous alignment of:

- Predominantly project-based new demand – (each significant new end-user – e.g power plant, industrial users, mine site)
- Incremental gas transportation capacity between the gas supply point and the end-users delivery point requiring step change augmentation (compression, looping or new pipelines)
- New onshore mid-stream gas processing capacity aggregating offshore raw gas supply (to clean up the raw produced gas to pipeline quality specifications)
- New upstream gas supply (particularly offshore gas facilities and pipelines)

As each of these necessary components require significant business investment undertakings in themselves, the alignment of all four components is required to see delivered gas volumes change, resulting in stair step or “lumpy” look overall.

End user demand: New gas demand begins with the gas needs – the WA market is characterised by the dominance of project related demand points (ie gas-fired power plants, mining sites, large industrial loads) and growth through either a green-field development project or expansion of an existing “brown-field” project rather than incremental demand growth. Examples of new projects are; Burrup Fertilisers, Wambo power, South West Cogeneration facilities etc.

Pipeline capacity: Starting with the end-users and looking up the gas delivery chain, the next essential component for realizing increased gas demand is the gas transmission pipeline capacity. Gas pipelines in WA have remained at near full capacity, causing new demand to wait until the pipeline capacity can be expanded. Typically pipelines require a critical mass of customer volumes and term commitments to underwrite expansions of gas transmission capacity. Expansions of gas transmission pipelines are costly (see Table 6 in Section 5 - Recent WA Gas Transmission Expansions) and present major logistical challenges. Pipelines operators typically have cost effective throughput plateaus for their systems which can cause them to wait until these threshold volumes of shipper commitments can be contracted. For example, adding one compressor may deliver a fixed amount of capacity, yet to add the next incremental 1 TJ/d capacity may require a far more elaborate expansion which may not be regarded as prudent by owners or regulatory overseers.

Gas processing capacity: The next essential component in the gas delivery chain is the need for midstream gas processing capacity, which can also be a constraint to the overall gas market demand. Gas must be processed to meet the quality specifications of pipelines. Most of WA’s gas processing facilities have operated at or near capacity. For material incremental volumes to be delivered, additional gas processing capacity must be added. As an example, the addition of East Spar and later John Brookes gas fields to Varanus island has led to incremental expansions in the past and resulting in incremental gas sales.

Gas supply: The final essential ingredient for increased gas demand to be realized is of course the connection of incremental gas production. As an example, with the natural depletion of East Spar, Apache developed and connected John Brookes field so that additional GSA’s could be secured and served.

It takes the alignment and coordination of all four supply chain elements to realize increased gas demand (gas supply, gas processing, gas transmission, and a gas market / end-users). The alignment of all of these elements results in a more difficult to co-ordinate, “lumpy” gas market growth compared to other markets where supply and demand growth is more “incremental”.

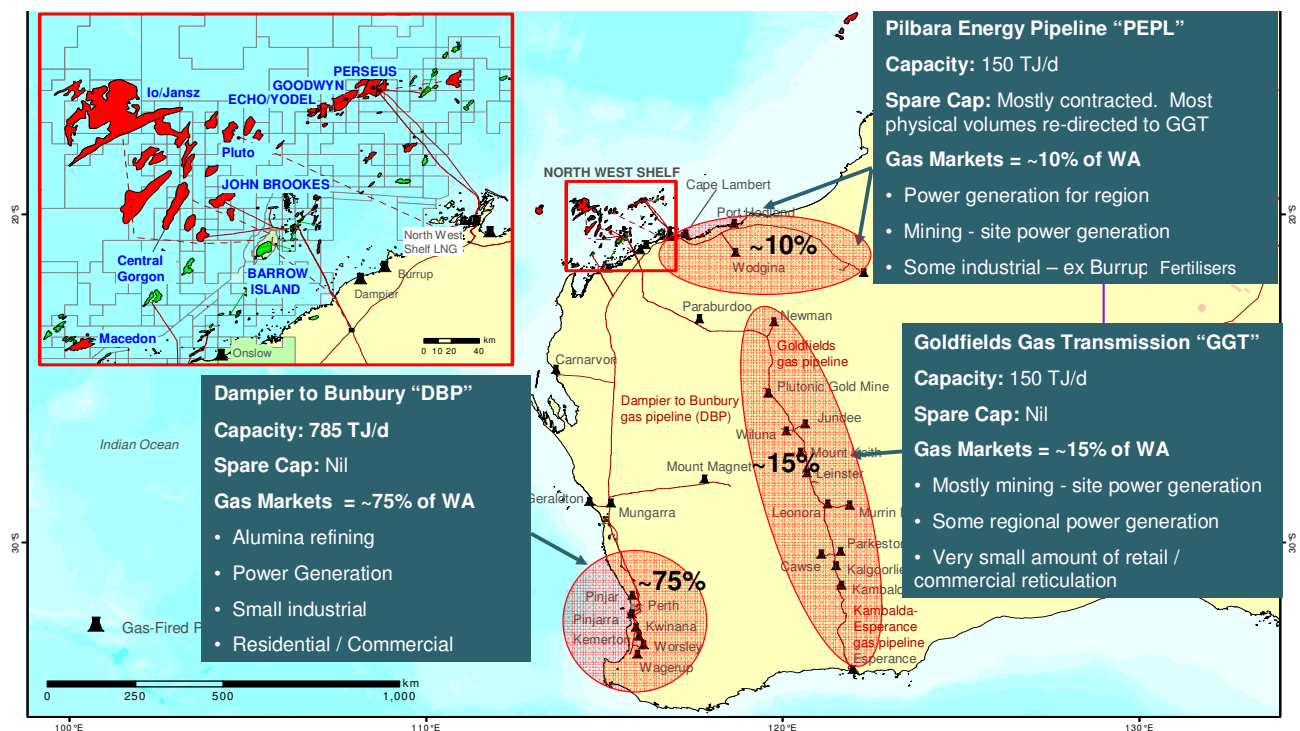
Location of WA’s domestic gas markets

An obvious means of ascertaining where WA’s approximate 900 – 1,000 TJ/d gas markets are located is to look to the two primary gas transmission pipelines (the DBP and the GGT). These two pipelines are currently fully contracted at 785 TJ/d and 130 TJ/d, respectively (see Section 5 of this report), which accounts for the majority of the total gas flows in WA, with the balance of the market being in the Pilbara (supplied by the PPS pipeline). The DBP does deliver some minor volumes of gas in the Pilbara and mid-west to markets including the city of Carnarvon and the mid-west pipelines to Windimurra, however, the vast majority of the DBP gas flows come to Perth and south of Perth.

In summary, the gas demand in WA is distributed generally as follows:

- Pilbara – approximately 10% of the WA market comprised of power generation, mine site power generation and some industrial use (ex Burrup Fertilisers, and EDL Maitland estate mini-LNG).
- Goldfields – approximately 15% of the WA market comprised of mine site power generation, retail power generation, and reticulated residential and small commercial customers.
- Perth and south of Perth – approximately 75% of the WA gas market and is comprised of Alumina manufacturing, power generation, residential, commercial and industrial customers.

Figure 3 WA Gas Market Locations and Make Up



Make up of the WA gas market

This sub-section provides comments on the end-use categories of demand in WA and identifies the drivers and nature of growth in each of these end-use categories. For the purposes of this analysis we have defined WA’s gas end-use categories as:

- Alumina
- Power Generation
- Retail (including Residential, Commercial, Industrial)

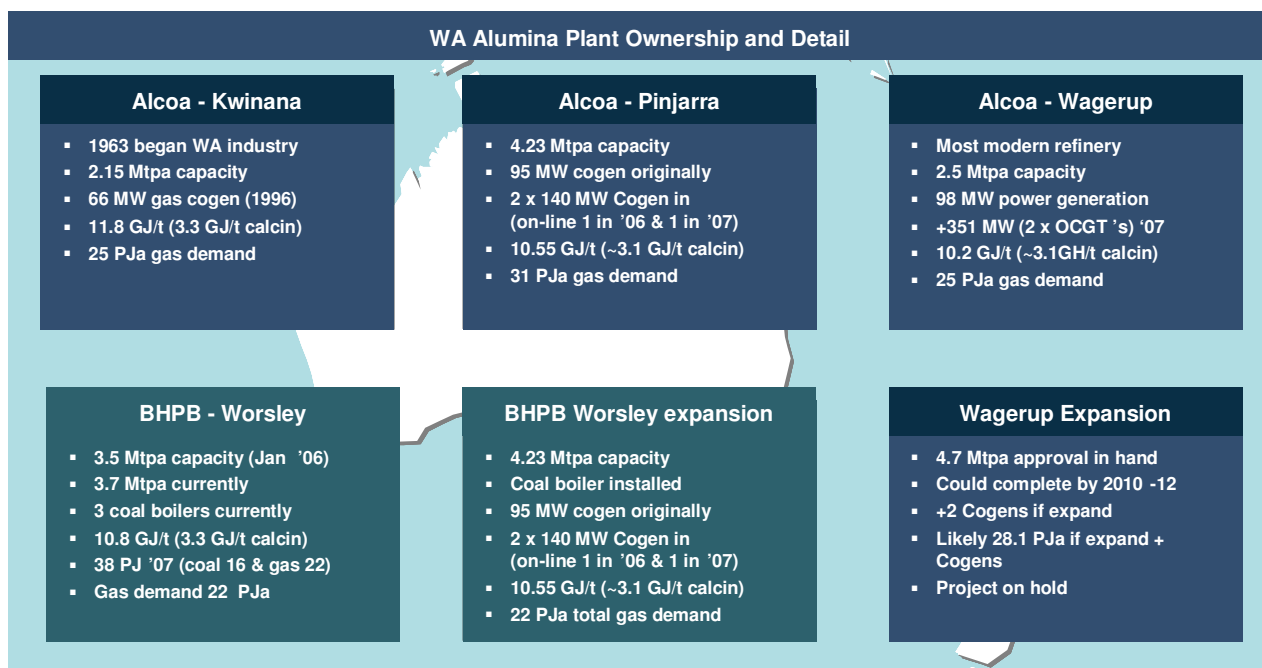
- o Mining (primarily Iron Ore, Nickel and moderate Gold demand)

The remainder of this sub-section provides comments on each of these gas end-use categories and identifies the nature of gas demand growth within each category.

Alumina:

The refining of bauxite into Alumina is one of the largest gas end-uses in WA, making up approximately 250 TJ/d of gas demand currently in WA. WA production of Alumina has been as high as 29% of the global supply in recent years.⁵ There are currently 4 major Alumina refineries in WA – all located south of Perth:

Figure 4 WA Alumina Plant Ownership and Gas Demand



Gas is used in the Alumina process for steam and calcination, as well as the possible secondary production of electricity. Gas has been a preferred fuel, however, both fuel oil or coal can be used for steam raising. Steam raising can represent two thirds of an Alumina plants energy needs. Alcoa’s WA operations began with fuel oil fired boilers before gas supply was available. Coal can also be used, as seen recently with BHPBilliton’s decision to expand their Worsley facility through the addition of a coal fired boiler. Typically one third of the energy needs for an Alumina plant will be for calcination, which must be satisfied by either gas or liquid fuels (fuel oil).

Future growth in WA Alumina production will hinge on global demand growth for Alumina as well as the competitiveness of WA’s Alumina production. Gas demand for Alumina in WA will therefore depend on the global growth in this sector, the overall relative cost of supply of Alumina from WA which in turn is somewhat linked to the relative competitiveness of fuel input cost (be that gas versus coal). As can be seen in the project consumptions in the above table, an Alumina plant or expansion of an existing plant typically requires an incremental 20 – 25PJ/a (55 – 68 TJ/d) gas supply. Once flowing, a new facility or expansion may appear as a “lumpy” increase in the context of the WA total gas demand.

Power generation:

Power generation gas demand can also appear to be “lumpy” due to the scale of gas consumption for each power generation facility. Gas demand for a power plant is determined by the plant type (OCGT or CCGT), efficiency rate and the dispatch period of the plant. By way of example a base load gas fired power plant of 300 MW may consume 60 TJ/d of gas supply, or approximately 2.5 TJ/hour. If the power plant is utilized as a mid-merit or peaking plant the gas supplies needed can be reduced dramatically for total daily amount consumed. For example, a OCGT dispatched as a

⁵ http://www.alcoa.com/australia/en/info_page/refining.asp

peaking plant for say 2 hours only, the plant would consume only 5TJ/d for that day, however, for those two operating hours it would be consuming gas at a rate comparable daily rate equivalent to 60 TJ/d.

Gas fired power generation is generally preferred for mid-merit and peaking needs due to its flexibility and cost. Matching gas supply and gas transportation arrangements for these intermittent and short term operational burns can be problematic. Fitting these needs within the contracting and scheduling requirements for both gas production and gas transportation operators is challenging. Typically gas producers and pipeline companies will want firm commitments for the maximum volume which could be consumed by the power plant in a day. The hourly takes are then limited to the daily volumes divided by 24 hours, with some tolerance allowed for hourly over-runs by the pipeline operator. The out-workings of the gas supply and transportation systems requirements can cause a mid-merit or peaking power plant operator to reserve and pay for 60 TJ/d of gas supply and pipeline capacity even though this may only be fully utilised for small periods over a year.

Gas demand for power generation in WA is currently approximately 150 TJ/d. Approximately 60% of WA's power generation is gas fired. Natural gas will likely continue to be a preferred fuel due to its clean environmental aspects versus burning coal or oil, plus the quick turn up and down capability of natural gas fired generation which make it ideal for mid-merit and peaking power generation. Due to the increasing amount of base load and mid-merit coal fired power generation, as well as intermittent (wind) power on the SWIS, Wood Mackenzie expects an increasing amount of gas fired power generation will be needed to balance the SWIS system. Wood Mackenzie estimates the overall gas demand for power generation will increase materially in the next 10 years, potentially doubling to 300 – 350 TJ/d.

Retail:

As a whole, this sector typically grows modestly (at 1 - 3% per annum) driven primarily by organic growth. Retail in this analysis captures residential, commercial, and industrial gas demand.

A small component of this gas demand category is the residential sector which is quite stable and grows with population.

The commercial and industrial gas demand makes up the majority of this category and captures a large number of end-users in a wide variety of business. Due to this wide array of businesses, and given the general population increase, the sector overall is expected to demonstrate steady and slightly increasing gas demand.

Mining:

This end-use category in aggregate can reflect volatile gas demand as projects begin and end. Gas demand in this sector is primarily for mine-site power generation for Iron Ore, Nickel and Gold mining.

Overall the sector has continued to grow despite some great volatility in commodity prices. There have been project failures in this category that occasionally result in quick downturns in gas demand:

- BHPBilliton's Port Hedland HBI plant. The abandonment to this project ended gas demand for an estimated 100 – 120 TJ/d, however, these gas supplies were in time reallocated to BHPBilliton's broader portfolio needs which are mostly Nickel mining operations on the GGT and Alumina.
- The 2004 closure of Xstrata's operated Windimurra Vanadium mine due to commodity price fluctuations. The mine is currently in the process of being re-developed⁶ and may soon return as a mining gas consumer.

A positive example of a mining project causing a "lumpy" gas demand increase, will likely be experienced when CITIC Pacific Mining (Sino Iron Ore Project) begins taking gas from Apache/ Santos's Devil Creek gas processing plant. From the Apache / Santos announcement of a Gas Sales Agreement (GSA) secured with CITIC Pacific Mining,⁷ this project will take approximately 60 TJ/d of gas supply once the Sino Iron project commissions.

Iron Ore holds the significant potential for increasing gas demand in the mining sector. There are two types of Iron Ore which required differing amounts of mine site energy:

- Hematite Iron Ore requires energy at mine sites for electrification of conveyors, lighting, etc, which represent only approximately 3-5% of a Hematite Iron Ore mine's FOB costs. However it is important to note that the scale of these operations can be very large and individual operations can require in the order of 30-40 TJ/d. Due to the remoteness of the projects and general lack of infrastructure, the alternative fuel to gas in these operations is diesel.
- Magnetite Iron Ore requires energy for electrification of mine site, conveyors etc as well crushing plants and for electromagnetic beneficiation of the iron ore. The significant power needs for crushing and electromagnetic beneficiation result in the overall energy needs for a Magnetite mine site being up to 40% of the FOB costs. As an example, CITIC Pacific's Sino Iron Project is estimated to have contracted 60 TJ/d of gas supply.

⁶ www.pmal.com.au/about_windimurra.16.html

⁷ Santos Media Release, "*Santos signs US\$585 million Sino Iron gas supply contract*", 7 Jan 2009

Iron Ore demand for the region is expected to continue to grow materially, but will be seen as “lumpy” increases in gas demand as new mines are connected to gas supplies.

Summary of change in WA domestic gas customers and their requirements

WA has experienced significant growth in total gas volumes contracted from 1998 to 2009, increasing from approximately 640 TJ/d to an estimated 865 TJ/d for 2009. From Wood Mackenzie’s data bases, the number of gas sales contracts to the WA gas market have increased over this period from approximately 22 contracts in 1998 to a high of 33 active contracts in 2005, falling to 26 currently active contracts in 2009. Despite this increase in volume and number of contracts, the concentration of major buyers and major sellers remains relatively similar to 1998, with the majority of the gas market comprised of only 5 buyers.

Future domestic gas consumption in WA is expected to increase. ABARE estimates WA’s primary consumption of gas to increase materially to 750 PJ/a by 2029-30⁸⁹

⁸ Australian Energy Regulator, “*State of the Energy Market 2008*”, p 229

⁹ Australian Energy: “*National and state projections to 2029-30*”, ABARE research report 07.24, 2007.

Section 4: Number of Suppliers and Available Reserves

In this section Wood Mackenzie has extracted information from our Upstream Service which provides a comprehensive summary on each of the material WA gas supply alternatives – whether connected (commercial), or non-connected (technical). Connected gas supplies will be examined first, and then a broader view will be taken as to the changes on the overall Carnarvon Basin gas supply situation.

Reference Point – 1998 WA domestic gas suppliers – by field

The 1998 ACCC determination referenced the following gas reserves available to the WA domestic market in 1998.

Table 2 1998 WA Gas Reserves (PJ)

Gas Field	Basin	Proven	Probable	Comments
Beharra Springs	Perth	28	30	Limited available
Dongara	Perth	21		No availability
Woodada	Perth	32	84	23TJ/d available for 10 years
Thevenard Island	Carnarvon	45	47	10-12 TJ/d available for 10 years
Griffin	Carnarvon	26	45	Limited available
East Spar	Carnarvon	400		No availability
Harriet	Carnarvon	143	173	
Tubridgi	Carnarvon	65		At most 4 TJ/d for 10 years
NWS	Carnarvon	18,830		
Macedon	Carnarvon	698	1036	Hi inerts only meets GGT specs
Scarborough	Carnarvon			Undeveloped
WA-248-P	Carnarvon			Undeveloped

10

Gas sales in Western Australia in 1998 were contracted for from a number of gas fields including; North West Shelf Venture, Beharra Springs, Harriet Area, Dongarra, Woodada, Griffin-Tubridgi.

Update- 2009 WA domestic gas suppliers - by field

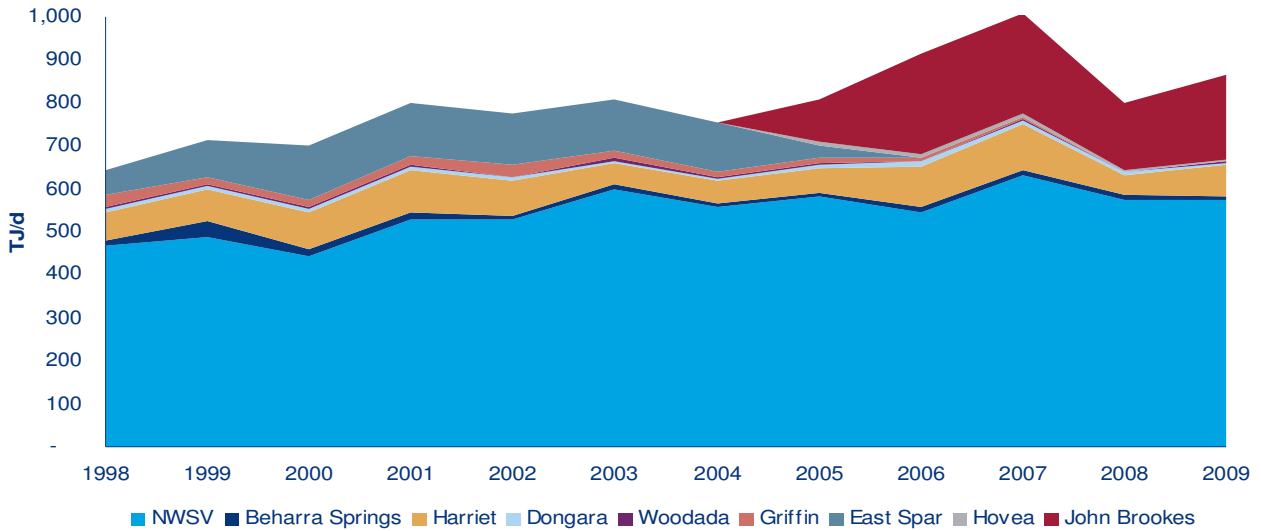
There have been a number of changes to both the reserves position and gas sales from the producing assets highlighted in the 1998 ACCC determination referenced in the table above. Gas reserves have increased dramatically with the discovery of a number of large, new gas fields in the offshore Carnarvon Basin as can be seen in Appendix 3. The reserves position for WA from the Carnarvon and Perth basins are outlined below (note: additional discovered gas resources occur in the Browse Basin but due to the remoteness from the main demand centres in central and south-west WA, the Browse Basin is addressed separately later in this report). Appendix 3 provides a break out of gas resources by field in the Carnarvon, Browse and Perth Basins.

In terms of gas production, a number of the gas fields/processing facilities outlined in the ACCC 1998 determination have ceased production. The processing facilities that are no longer producing sales gas include the following – Woodada, Thevenard Island, and Tubridgi (which processed sales gas from the Griffin field) facilities. Some of these fields/facilities are now being assessed as potential storage facilities. In addition, the offshore East Spar field has also depleted but has been replaced by the development of the John Brookes field. The Beharra Springs facility is expected to cease production in 2010/11.

Gas sales by field to the WA domestic market over the period from 1998 to present can be seen in the following graphic. This graph illustrates the importance of three key processing facilities, the NWSP Domgas facility, John Brookes JV Varanus Island facility and the Harriet JV Varanus Island facility as the key production centres for the WA Gas Market.

¹⁰ ACCC Determination, “Application for Authorisation North West Shelf Project”, July 1998

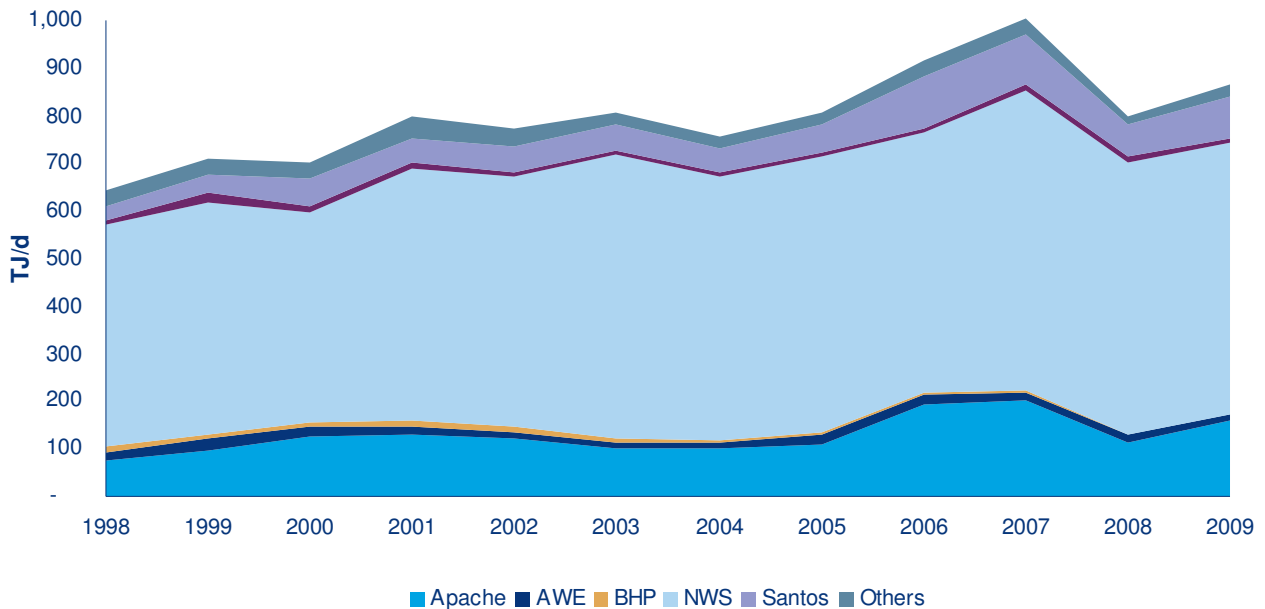
Figure 5 WA Gas Sales by Fields 1998 - 2009 (TJ/d)



WA domestic gas sales - by seller

Most gas fields in WA are sold under joint marketing arrangements with the exception of portions of the John Brookes field. The follow graphic reflects the total WA domestic market gas sales volumes by “seller”.

Figure 6 WA Gas Sellers/Production Facilities 1998 - 2009 (TJ/d)



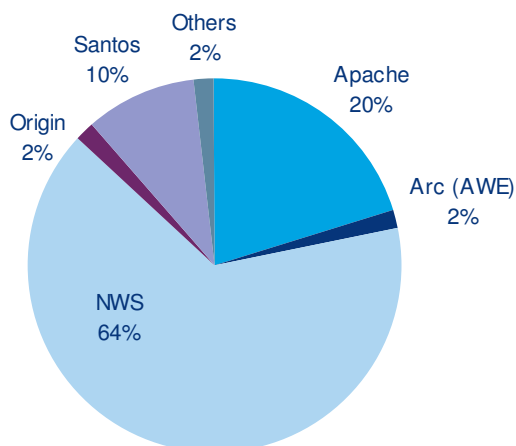
Source: Wood Mackenzie

It is clear from the graphic above that volumes of gas sales have increased in WA between 1998 and 2009.

The graphics on the following page, however, highlight that little has changed from 1998 to 2009 in terms of percentage of gas sales to the WA market by gas seller. Notably the NWSP gas sales has increased from an estimated 467 TJ/d in 1998 to an estimated 572 TJ/d in 2009.

Figure 7 WA Gas Sellers 1998 and 2009

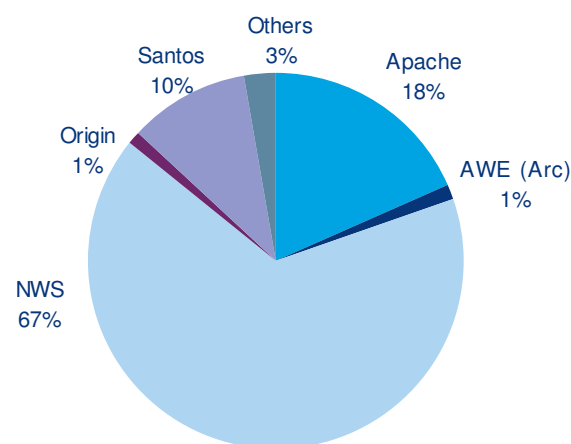
WA Gas Sellers 1998



■ Apache ■ AWE ■ NWS ■ Origin ■ Santos ■ Others

Source : ACCC 1998

WA Gas Sellers 2009



■ Apache ■ AWE ■ NWS ■ Origin ■ Santos ■ Others

Source : Wood Mackenzie's estimates
Remarks : *Others - Tap Oil, KUFPEC

Gas sales to the WA domestic gas market continue to be predominantly from the NWSP. Adding the gas sales of Apache Energy and Santos Joint Ventures currently make up 95% of the gas sales to Western Australia.

WA Domestic gas sales by joint ventures:

The majority of domestic gas sales in WA are accommodated through joint venture sales. The following table details the major joint venture parties, their proportionate ownership, and their percentage of the WA domestic gas market.

Table 3 Joint Venture Ownership and Percentage of WA Market Sales

Venture	Company	Ownership	2009 % WA Market
John Brookes	Santos	45%	22.9%
	Apache	55%	
Hovea Area	AWE	50%	0.4%
	Origin Energy	50%	
East Spar	Santos	45%	Depleted
	Apache	55%	
Griffin Area	INPEX Corporation	20%	Depleted
	ExxonMobil	35%	
	BHP Billiton	45%	
Woodada	AWE	100%	0.2%
Dongara Area	AWE	100%	0.6%
Harriet Area	Tap Oil	12%	8.4%
	KUFPEC	19%	
	Apache	69%	
Beharra Springs Area	Origin Energy	67%	1.3%
	AWE	33%	

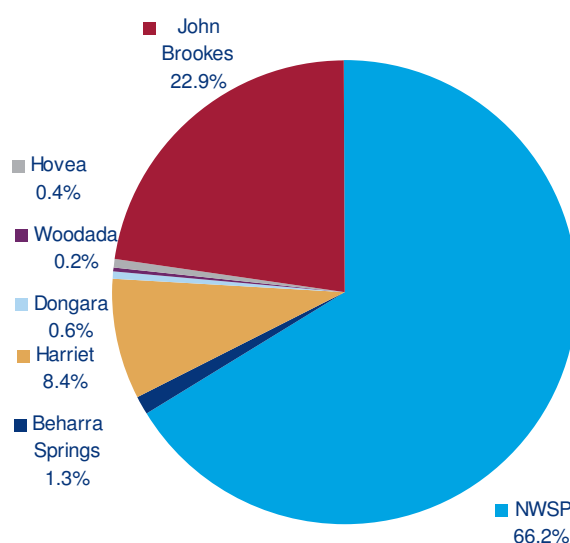
NWS Gas Project ¹¹	BHP Billiton	8.33%	66.2%
	BP	16.67%	
	Chevron	16.67%	
	MIMI	0%	
	Shell	8.33%	
	Woodside Petroleum	50%	

Source: Wood Mackenzie

Note: Historically the equity proportion of gas sales from NWSP has been as outlined in the table above. However any new gas sales will most likely be by all parties (including MIMI) at an equity of 16.67% each.

Another reflection of Joint Venture selling can be seen in WA gas market sales by field/project.

Figure 8 WA Gas Market Share by Joint Venture 2009



It should be noted that Wood Mackenzie’s review of Gas Sales Agreements (GSA’s) indicate that not all of John Brookes and East Spar fields have been jointly marketed. The majority of John Brookes volumes are sold jointly under three GSA’s, however, Santos has established an estimated five GSA’s solely. This is believed to be due to Santos having a more robust view of the field reserves¹². East Spar gas has been jointly sold through six market contracts, however, Apache is understood to have taken some of the East Spar volumes to off-set their share of shortfalls in Harriet joint venture.

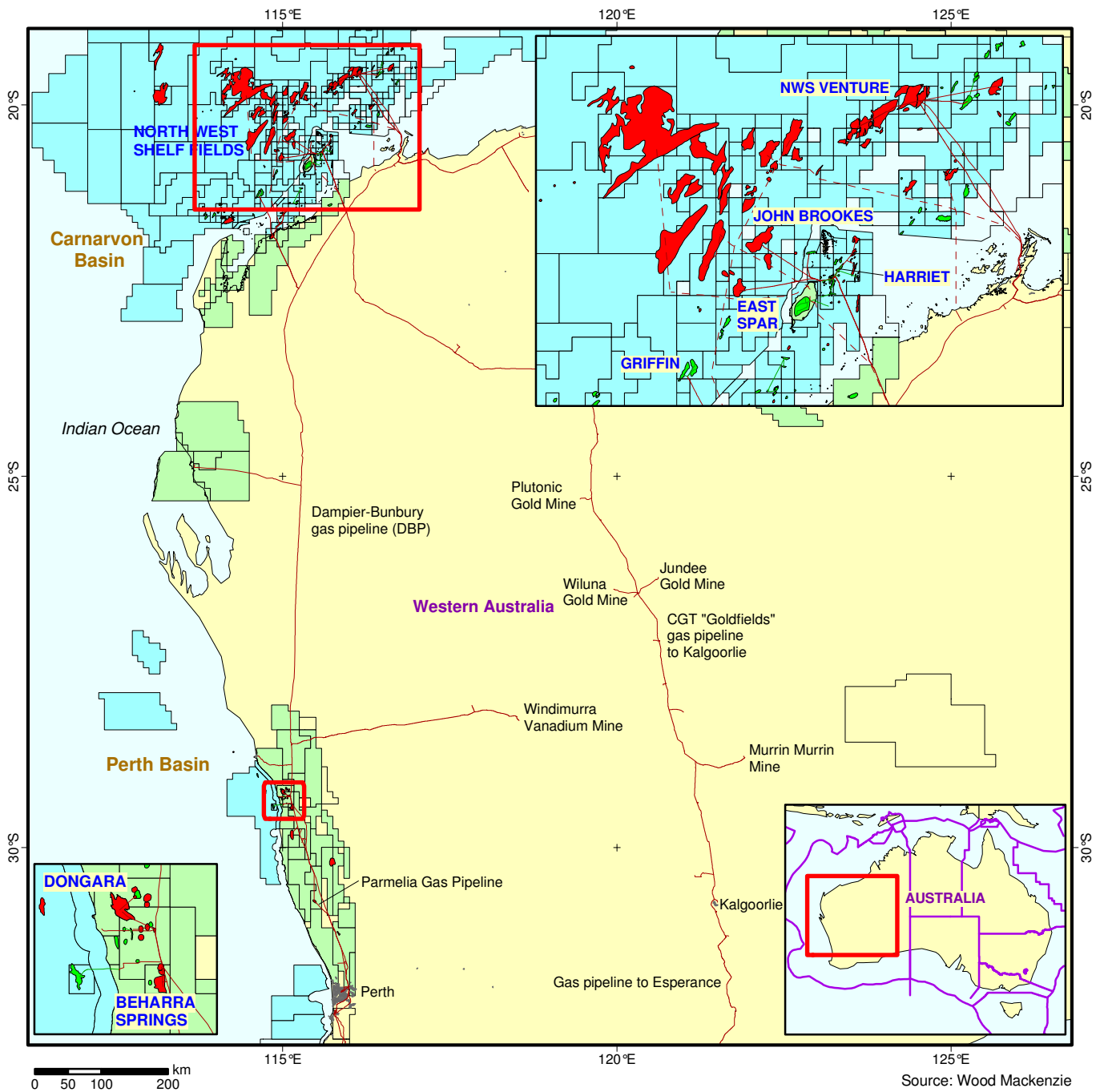
WA gas fields by commercial and technical resource

The previous section addressed gas sales to the WA domestic market. In this section Wood Mackenzie looks at all the known gas fields which are proximate to the WA domestic gas market and could potentially be connected to the WA gas market. To keep this analysis relevant to the current state of the WA gas market the analysis has been constrained to only gas fields in the Carnarvon Basin. The Browse Basin has had significant discoveries, however (as can be seen in Appendix 3), at this time there is no clarity on when those gas fields may become developed or available to the WA domestic market. The Browse Basin is addressed later in this section. The following map highlights the material Carnarvon and Perth Basins gas fields which have supplied the WA domestic market for the last ten years.

¹¹ Note: NWS sales up to 550 TJ/d Woodside retains 50% share. For incremental sales above the threshold all partners (including MIMI) will have an equal 16.67% share as reflected in the table above. The threshold volume was reduced to 414 TJ/d effective from 1 July 2005.

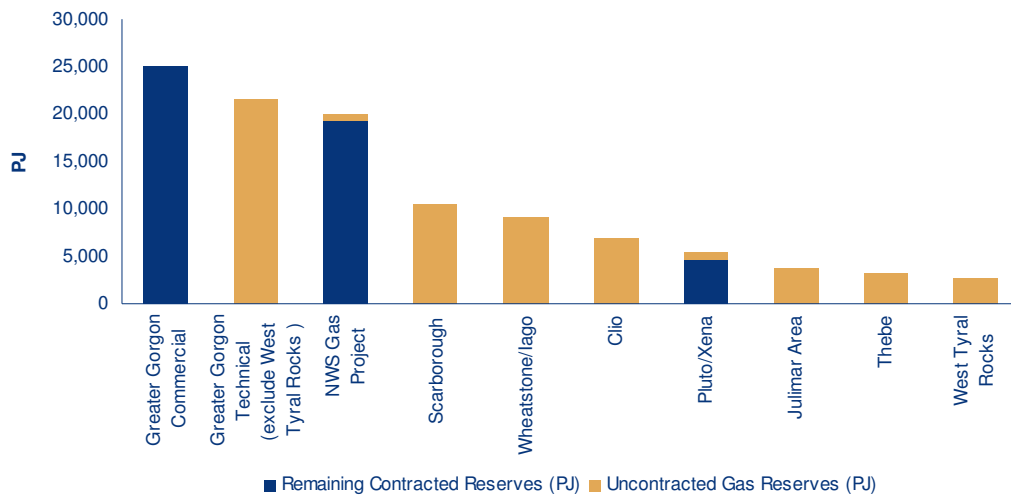
¹² Gorgon Draft Determination, “Submission from the Domgas Alliance”, 8 June 2009, p54.

Figure 9 Carnarvon and Perth Basins with Major WA Gas Supply Fields



Wood Mackenzie classifies all known gas discoveries by two definitions; “Commercial” (reserves which are committed under announced commercial contracts), and “Technical” (known P50 reserves which are un-contracted). As there are now a large number of gas fields discovered in the Carnarvon Basin, the fields have been grouped by size in each of the following three graphics; above 2,000 PJ, between 200 and 2,000 PJ, and below 200 PJ. Appendix A provides details on all Carnarvon basin fields above 200 PJ and provides details on; produced volumes, currently contracted volumes, and remaining un-contracted volumes. The table also show the retention licence and expiry dates for respective fields.

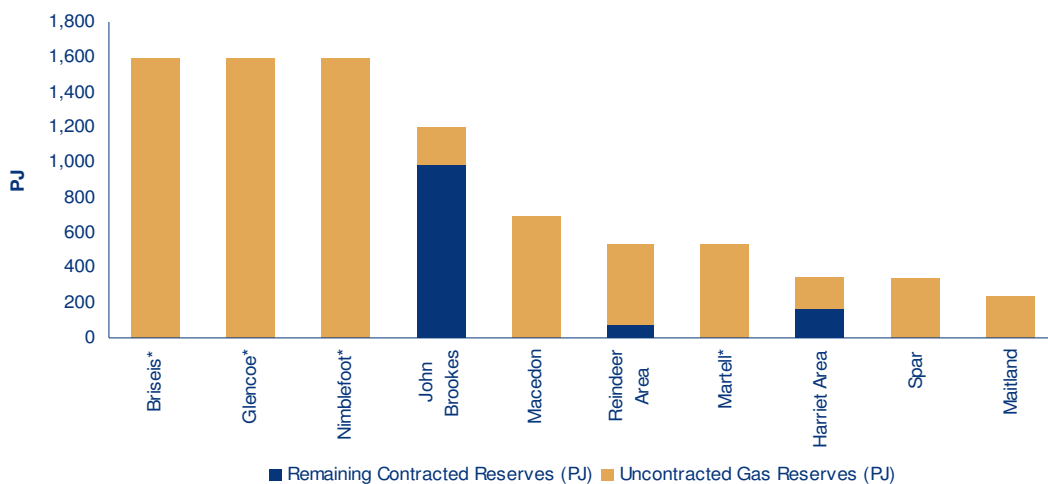
Figure 10 WA Gas Fields Commercial and Technical Reserves (> 2,000 PJ)



Source: Wood Mackenzie

The above graphic captures the largest known gas fields in the Carnarvon Basin, showing volumes which have commercial contracts as well as volumes deemed “technical” – i.e. known but not yet developed and currently without off-take contracts. With the NWSP and the Greater Gorgon area, there are multiple fields associated with these projects. A significant proportion of the contracted reserves are associated with LNG contracts with 15 to 20 year duration. We have therefore grouped the fields under the single project name rather than breaking down the reserves on a field by field basis. A large number of gas fields have been discovered in the last ten years. Given the scale of the reserves base, most of these volumes are being considered for development in LNG projects although associated domestic gas development is also possible. With the WA Domestic Gas Reservation directive, associated domestic gas plant developments are expected as part of new onshore LNG developments. However at this stage, apart from the Pluto and Gorgon LNG developments, future developments remain unclear.

Figure 11 WA Gas Fields Commercial and Technical Reserves (< 2,000 PJ ; > 200 PJ)



* indicates Wood Mackenzie speculative estimate only
Source: Wood Mackenzie

For example, the Julimar area fields are believed to have been initially targeted for the domestic gas market as a possible supply into an expanded Devil Creek gas processing project. However, Apache / Kufpec have recently announced they plan to develop these fields as part of Chevron’s proposed Wheatstone LNG project. At this stage there

are no detailed plans for the associated domestic gas plant (expected under the Domestic Gas Reservation directive) for the proposed Wheatstone LNG development.

The previous graphic highlights the known Carnarvon Basin gas fields of moderate size (between 200 PJ – 2,000 PJ). The first three fields Briseis, Glencoe and Nimblefoot are recent deepwater gas fields discovered by Hess. Wood Mackenzie’s reserves estimates at this stage remain highly speculative as very little information has been reported by Hess at this stage. Hess’ plans for development of these fields remains unclear and Hess continues to proceed with further exploration drilling in this area.

The Reindeer field is currently being developed and will come into the WA domestic market through the Apache operated Devil Creek gas processing facility – now committed for construction.

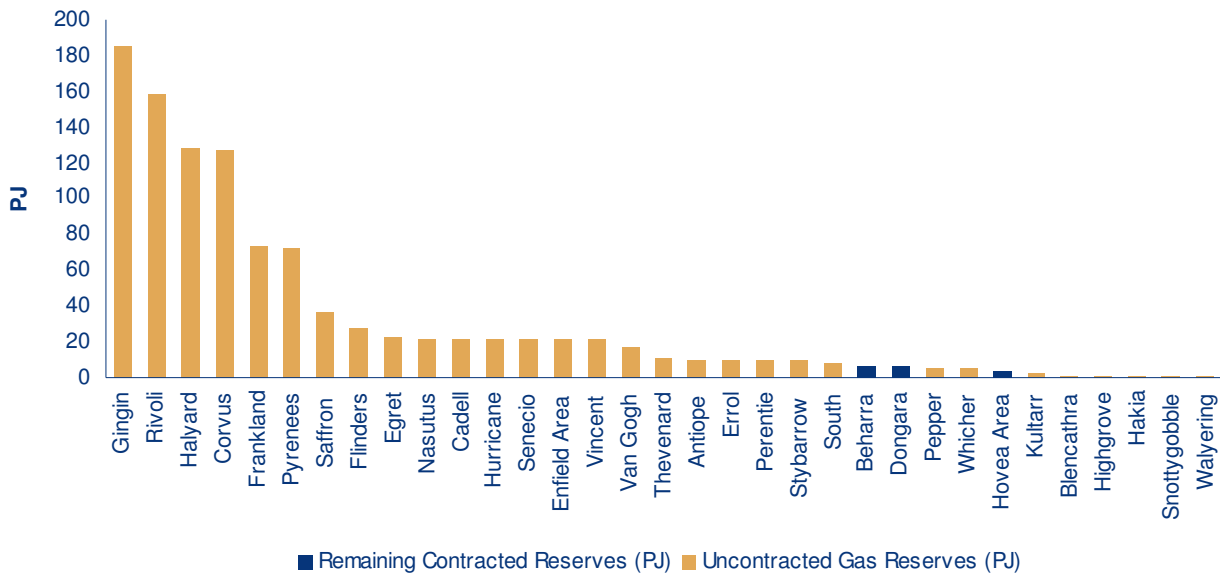
Macedon field has now entered FEED, and may potentially serve the WA domestic market – although no gas sales agreements have been announced to date.

The Martell field is a Woodside operated field which will likely be developed into Woodside’s Pluto expansions.

The Spar field is uncommitted and un-developed and would likely require processing through Apache’s Varanus Island facilities. The Maitland field is an Apache operated field which is between John Brookes and East Spar and may likely be brought into the nearby John Brookes pipeline once there is capacity – most likely upon the decline of the John Brookes field.

In summary, of all the “mid-sized fields” identified above, only Reindeer and Macedon fields hold promise of stand-alone medium term delivery of incremental gas volumes to the WA domestic market.

Figure 12 WA Gas Fields Remaining Commercial and Technical Reserves (< 200 PJ)



Source: Wood Mackenzie

The graphic above shows the smaller known gas fields in the Carnarvon Basin – under 200 PJ. Generally speaking, offshore gas fields under 200PJ are viewed as being too small to commercially justify independent development of new gas processing and connection to transmission infrastructure. Of the larger fields in this list, they either have challenges in regard to distance from infrastructure or are more likely to be sequenced into existing gas processing infrastructure in the future as capacity becomes available. In particular the Rivoli, Corvus and Frankland gas fields are all off-shore and do not currently have reserves certainty or scale to justify independent connection and gas processing infrastructure. Halyard is an Apache operated gas field and may in time be connected to Varanus Island facilities as capacity becomes available. The Pyrenees Area fields are close to the Macedon field and could be developed into any future Macedon facilities if this proceeds. The remaining fields are below 50 PJ and are not viewed as economically viable under current market conditions.

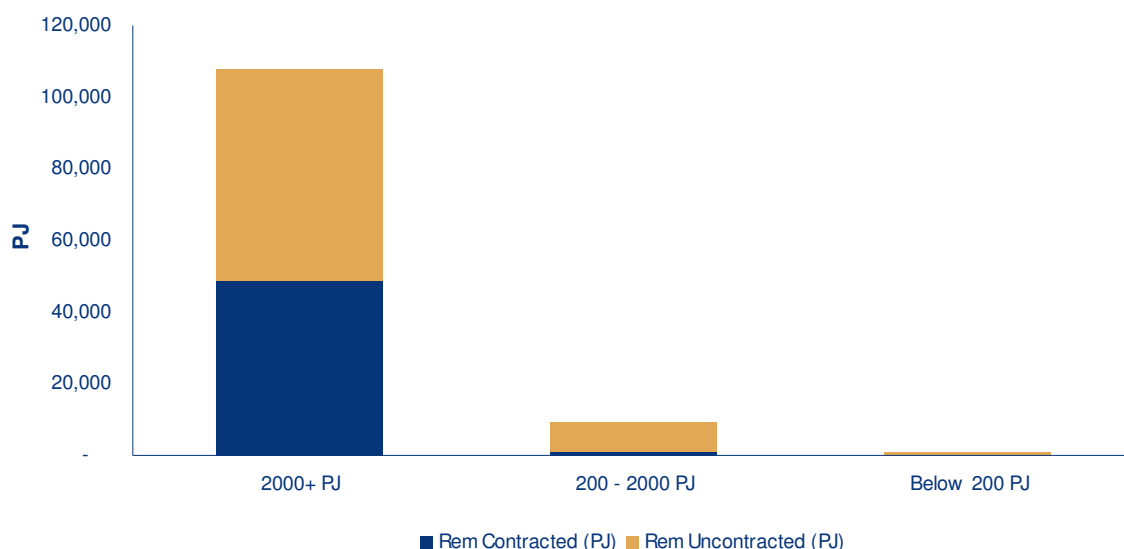
The following table and graphic summarizes the Carnarvon Basin fields by number, size and committed volumes.

Table 4 Carnarvon Basin Number of Gas Fields and Available Volumes

Field Name	No of Fields	Produced Volume (PJ)	Rem Contracted (PJ)	Rem Uncontracted (PJ)	Total Reserves (PJ)
2000+ PJ	10	13,207	49,006	59,139	121,352
200 - 2000 PJ	11	698	1,230	7,702	9,630
Below 200 PJ	33	632	16	1,058	1,706

Source: Wood Mackenzie

Figure 13 WA Carnarvon Basin Contracted and Uncontracted



Source: Wood Mackenzie

The illustration above highlights that the majority of WA’s gas endowment is in the large fields. All fields in this category (2000+PJ) are being considered as various possible LNG developments. These LNG aspirations may change as the Government’s position on retention leases are tightened in the future. For example where there are many fields that can make up a potential LNG resource, it has become contentious that all these fields can be locked up as part of the long term plans for the LNG development in isolation of development for the domestic gas market.

Domestic Gas Reservation directive may also influence how these field may ultimately be developed. Currently only Pluto and Gorgon LNG developments are proceeding Although their associated domestic gas projects still remain uncertain in regard to start up timing.

For Carnarvon Basin gas fields in the 200 - 2000 PJ category, several are also ear-marked as potential developments into LNG projects. Four fields are either already connected to the domestic market (two of the four) or soon to be connected, including:

- John Brookes (connected)
- Harriet (connected)
- Reindeer (committed)
- Macedon (FEED evaluation)

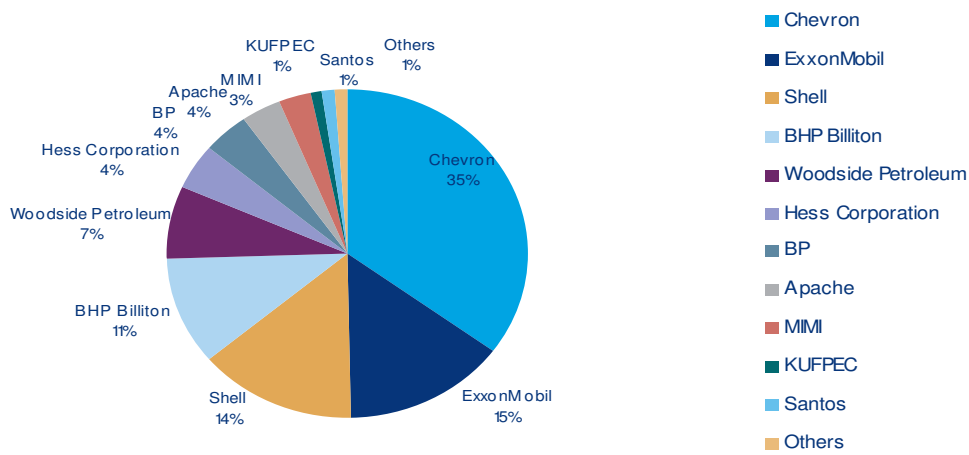
Remaining fields in the medium size category include Spar and Maitland. These two fields will likely be used for future backfilling of existing domestic or LNG production and have no immediate plans for development.

The population of smaller fields (below 200 PJ), only Halyard and Pyrenees hold promise to be sold to the domestic gas market, albeit likely in the distant future. Halyard will logically in time be connected to Apache Venture Varanus Island facilities as other connected fields deplete. Pyrenees is very close to Macedon and will likely be combined with any Macedon domestic gas project in time. All other fields in this category were regarded as too small or too remote to be developed independently.

WA gas fields by ownership and operator

The large volume of discovered gas reserves in the Carnarvon Basin provides the potential for medium to long term growth of gas production into the WA domestic gas market. An analysis of ownership of gas reserves in the Carnarvon Basin gas fields reveals a much larger population than the current sellers than is currently enjoyed in the WA gas market. The following two graphics highlight the many owners and operators of Carnarvon Basin (based on proven plus probable gas reserves).

Figure 14 WA Carnarvon Basin Gas Reserves Ownership (by percentage)

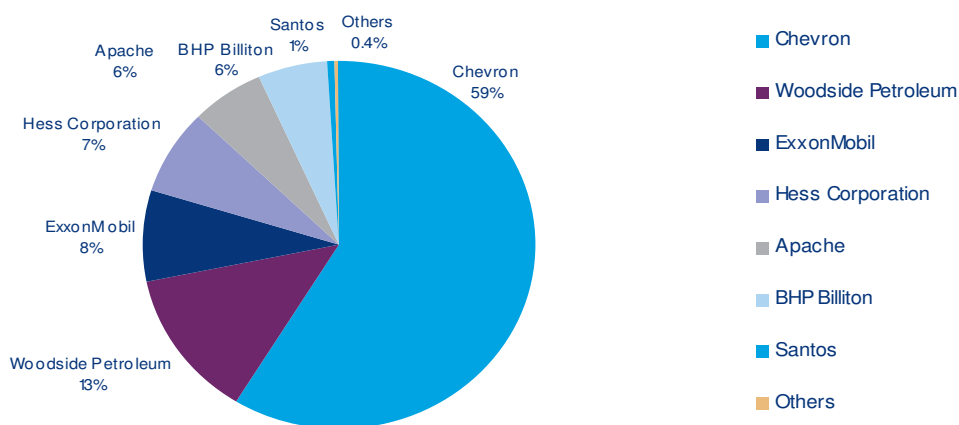


Remarks :

Others* - Kansai Electric, Tokyo Gas, Tap Oil, Empire Oil & gas, Stirke Oil, AWE, Victoria Petroleum, Wharf Resources, Pan Pacific Petroleum, Roc Oil, ERM Power, Bow Energy, Origin Energy, Mitsui & Co, OMV, INPEX Corporation, Advent Energy, Southern Amity, Eni, Itochu, Nippon Oil Corporation, Beach Petroleum, Mosaic Oil, Greenpower Energy

Source: Wood Mackenzie

Figure 15 WA Carnarvon Basin Gas Reserves by Operator



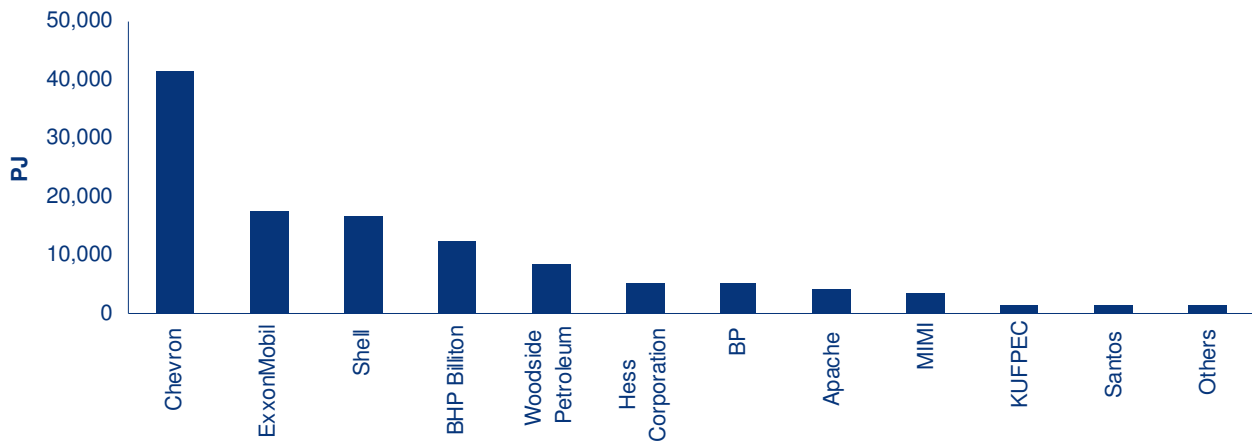
Remarks :

Others* - Empire Oil & Gas, Strike Oil, Roc Oil, AWE, Southern Amity, Origin Energy, OMV, Greenpower Energy

Source: Wood Mackenzie

Another perspective on the ownership of gas in WA is to look at gas volume owned and operated as can be seen in the next graphics.

Figure 16 Ownership of WA Gas Reserves (by Volume)

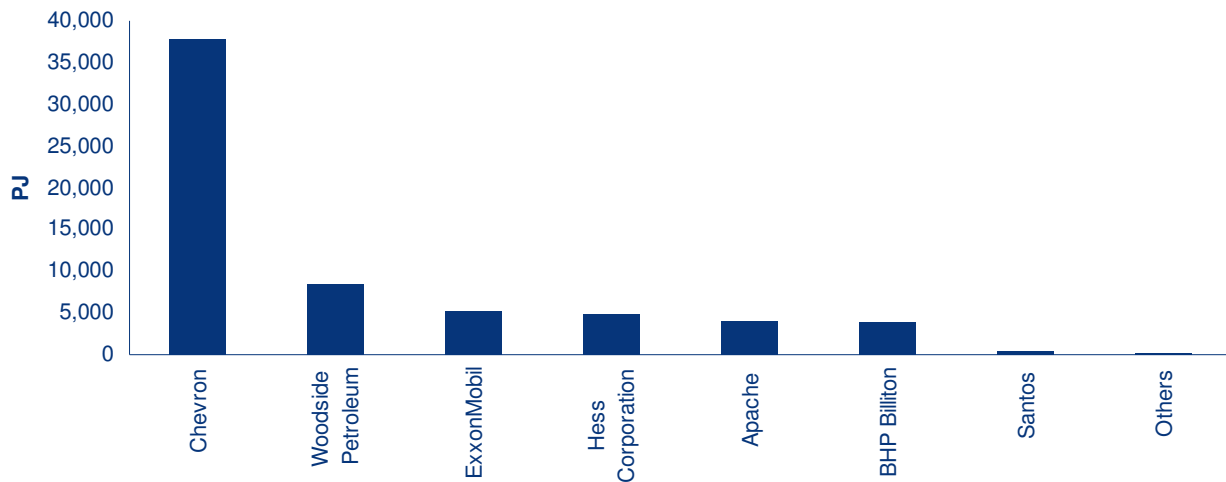


Remarks :

Others* - Kansai Electric, Tokyo Gas, Tap Oil, Empire Oil & gas, Stirke Oil, AWE, Victoria Petroleum, Wharf Resources, Pan Pacific Petroleum, Roc Oil, ERM Power, Bow Energy, Origin Energy, Mitsui & Co, OMV, INPEX Corporation, Advent Energy, Southern Amity, Eni, Itochu, Nippon Oil Corporation, Beach Petroleum, Mosaic Oil, Greenpower Energy

Source: Wood Mackenzie

Figure 17 Operators of WA Gas Reserves (by Volume)



Remarks :

Others* - Empire Oil & Gas, Strike Oil, Roc Oil, AWE, Southern Amity, Origin Energy, OMV, Greenpower Energy

Source: Wood Mackenzie

In summary, gas reserves in the Carnarvon basin are held by a large number of producers, however, the majority of these gas reserves are owned by less than ten producers and are operated mostly by the six producers seen in the graphic above:

- Chevron
- Woodside Petroleum
- Exxon Mobil
- Hess Corporation
- Apache Energy

- o BHPBilliton

Constraint of gas processing points

An important consideration in the development of sales gas into the WA domestic gas market is the capacity of the onshore processing facilities. The majority of gas produced into the WA domestic market over the past 10 years has been processed through two primary production points; NWSP Domestic Gas plant at Dampier and the Apache / Santos joint venture facilities on Varanus Island (East Spar/John Brookes). These facilities are currently at or near capacity. For domestic gas volumes to increase, new gas processing facilities will need to be developed. Apache/Santos are currently constructing a new onshore processing plant (called Devil Creek) which will process gas from their offshore Reindeer gas field development. BHP Billiton is currently assessing the potential development of the offshore Macedon gas field which will require new onshore processing facilities. In addition to these, under the WA Government Domgas Reservation directive, new onshore LNG developments will be required to allocate a proportion of the reserves (approximately 15%) to be developed for the domestic gas market. Both the Pluto 1 and Gorgon LNG projects (currently under construction) are evaluating the development of their respective domestic gas processing facility developments.

The following table highlights the primary gas processing infrastructure points and their respective capacities for delivering gas to the WA domestic market:

Table 5 WA Midstream Gas Processing Infrastructure

Facility	Operator	Capacity (TJ/d)	Comments
Varanus Island - (East Spar JV)	Apache Energy	240	also processes John Brookes
Varanus Island - (Harriet JV)	Apache Energy	120	
NWSV Domestic Gas	Woodside	700	
AWE Energy	Dongara	100	2009 approx 5 - 10TJ/d thrupt
Thevenard Island	Chevron	21	Ceased operation
Woodada	Hardman	10	2009 approx 2 TJ/d thrupt
Beharra Springs	Orign Energy	30	2009 approx 11 TJ/d thrupt
Onslow	Orign Energy	24	Ceased operation
Zyris	AWE / Origin	15	2009 approx 6 TJ/d thrupt
Prospective Facilities			
Devil Creek	Apache Energy	220	under construction
Macedon	BHPBilliton	up to 200	Possible project ~ 2012
Gorgon DomGas	Chevron	300	Target end 2015
Pluto DomGas	Woodside		by 5 years after 1st LNG

Source: Wood Mackenzie
Office of Energy, Energy Western Australia, 2003, p24f.

A number of gas fields highlighted in the previous section are not connected due to mid-stream capacity constraints which currently exists in WA - in particular:

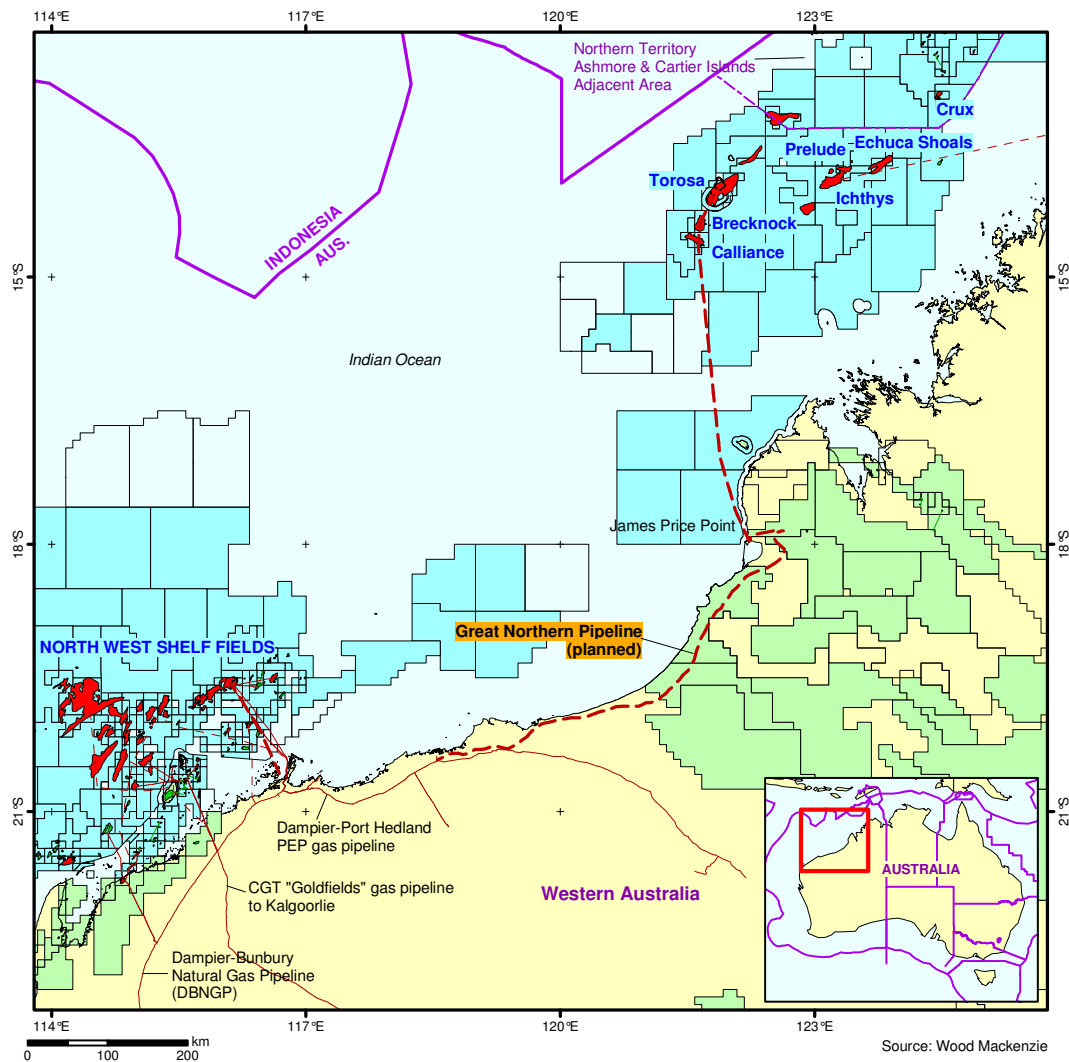
- o Halyard field – Operated by Apache, and is likely to be connected to the Apache/Santos Varanus Island facilities as capacity becomes available
- o Spar field – Operated by Santos, and likely to be connected to Apache/Santos Varanus Island facilities as capacity becomes available and if a gas processing agreement can be put in place.
- o Maitland field – Operated by Apache. Likely to be connected through John Brookes to Varanus Island as pipeline and gas processing capacity become available.

The necessity to align mid-stream gas processing capacity with upstream supplies as well as downstream pipeline capacity and customer demand can result in the perceived “lumpiness” of the gas market. Gas processing capacity must be available for incremental volumes to be seen in the gas market.

Browse Basin fields

The Browse Basin is not currently connected to the WA domestic gas market, however, is subject to WA's Domestic Gas directive and has experienced a number of significant gas discoveries in recent years. Browse Basin gas may ultimately enter the WA domestic market, however, in Wood Mackenzie's opinion will be many years in the future and will be burdened by additional transportation costs of the yet to be constructed Great Northern Pipeline. The following map highlights some of the significant gas discoveries in the Browse and their proximity to existing on-shore pipeline infrastructure.

Figure 18 Browse Basin Major Fields and Proposed Great Northern Pipeline



The Browse Basin has at present two medium term development projects which may potentially bring gas into the WA domestic market – the Woodside led Browse LNG project and the Inpex / Total Ichthys project. The Ichthys project looks destined to be piped to Darwin to supply a new LNG plant. If this eventuates, there will be no domestic gas for the WA gas market from Ichthys. Woodside is considering development of their Browse LNG project at the recently designated James Price Point LNG Hub near Broome. Should Woodside build their related Browse LNG facility at James Price Point or otherwise pipe the gas to supply an existing or new LNG plant on the Burrup Peninsula, the resulting WA on-shore LNG project would need to negotiate a domestic gas component as part of their State Agreement. If indeed Woodside were to develop Browse LNG near Broome, a gas pipeline would need to be constructed from the Burrup or Port Hedland to connect any new gas supply to the existing WA gas transmission systems.

Given the many uncertainties currently surrounding the timing of these two Browse LNG developments, as well as the logistical challenges of the developing a "Great Northern Pipeline", these incremental gas supplies are viewed as a potential reality only for the long term – i.e. beyond 10 years.

Note the Great Northern Pipeline was previously championed by Arc Energy (now AWE and Buru Energy) in the hopes of transporting their gas production from future discoveries in the Canning Basin. To date there have been no material or commercial gas discoveries in the Canning Basin.

WA's domestic gas reservation directive

In 2004 the WA Government put in place a Domestic Gas Reservation directive which sought to set aside the equivalent of 15% of exported volumes of gas for the domestic market for each WA land based LNG project. The application of this policy is to be negotiated within the State Agreement for each project. Consideration for this policy is evidenced in Gorgon's undertakings to provide 2,000 PJ of gas supply, up to 300 TJ/d.¹³ Pluto's domestic gas may be deferred as late as 5 years after first LNG.¹⁴

It is noteworthy that the volume commitment of Gorgon has not increased as the volumes of the Greater Gorgon field have increased – in particular with the addition of the Io Jansz discoveries, or as the scale of Gorgon has now increased to three trains for a total production of 15 Mtpa.

Domestic gas supply from future Carnarvon and Browse LNG projects will hinge upon the realization of each of the many proposed projects. One potential outworking of the WA domestic gas reservation directive is that WA may become awash with gas supply alternatives, however, the reality of this depends upon each of the WA projects securing LNG off-take agreements.

WA's Browse Basin fields are subject to the domestic gas reservation directive as well. As discussed in the previous section, any entry of Browse Basin gas supply to the WA gas market is not anticipated for some time, and will be handicapped by the added costs of transportation down the proposed Great Northern Pipeline.

Summary of changes in the WA gas supply scene

Since 1998 substantial new gas discoveries have been made which have materially added to Western Australia's gas reserves. However, there are limited gas supplies currently available, arguably a worse supply situation than in 1998. WA gas buyers currently advise they have very limited choices for additional gas supply into the WA gas market. Some of the recent issues with existing and potential domestic gas supply are listed below:

- In late 2006 the Harriet Joint Venture declared force majeure related to their GSA to Burrup Fertilisers – this dispute has not been resolved to date, and highlighted the inherent uncertainty in gas reserves.
- NWSP abandoned efforts in June 2007 to upgrade their domestic gas supply capacity (targeted potential expansion of an extra 100 TJ/d through the de-bottlenecking of existing facilities)¹⁵ after experiencing difficulties and failure to achieve designed increases.
- WA's Domestic Gas Reservation directive should result in medium to long term competing gas supply alternatives, however, this reality will be predicated on the successful delivery of each new LNG projects. At this time only Pluto and Gorgon are underway, with only Gorgon having clarity on timing and availability of domestic gas supplies.
 - **Gorgon** project's domestic gas establishment date has been extended to December 31, 2015 due to project delays¹⁶. Wood Mackenzie's understanding is that domgas will be subordinate to the completion, commissioning of Gorgon's LNG facilities, which involve complex logistics and therefore at risk of delays. In 2003, the partners signed the Gorgon State Agreement which reserved 2,000 PJ (1.85 tcf) of gas for the Western Australia domestic market. The partners only have an obligation to supply this gas if it is economic to do so. In November 2009, the Gorgon joint venture secured authorisation from the Australian Competition and Consumer Commission (ACCC) to jointly market 2,000 PJ of domestic gas into Western Australia until 31 December 2015. We expect domestic gas sales to begin in 2016.
 - **Pluto** domestic gas may be deferred as late as 5 years after first LNG.¹⁷ Timing of first domestic gas is therefore uncertain.

¹³ Draft Determination, "Applications for authorisation", 17 September, 2009, p10.

¹⁴ <http://www.mediastatements.wa.gov.au/ArchivedStatements/Pages/CarpenterLaborGovernmentSearch.aspx?ItemId=129601&minister=Carpenter&admin=Carpenter&page=3>, 4 November 2008.

¹⁵: www.thewest.com.au "Gas deals still done Woodside", 15th June 2007

¹⁶ Draft Determination, "Applications for authorisation", 17 September, 2009, p10.

¹⁷ <http://www.mediastatements.wa.gov.au/ArchivedStatements/Pages/CarpenterLaborGovernmentSearch.aspx?ItemId=129601&minister=Carpenter&admin=Carpenter&page=3>, 4 November 2008.

- NWSP domestic gas obligation likely satisfied by end 2013: Wood Mackenzie estimates the original NWSP domestic gas obligation to SECWA for 5,064 PJ¹⁸ will be satisfied during 2013. GSA's to these customers were disaggregated from the 1994 SECWA contract requiring 5,064 PJ be made available to WA customers.¹⁹ The NWSP customers were to be provided 550 TJ/d of gas supply through 2004 and 414TJ/d thereafter, until the domestic gas priority volumes had been met. In the 1998 ACCC determination, this obligation was estimated to be met by 2017. Due to more recent increases in NWSP domestic gas sales, Wood Mackenzie estimate the original SECWA domestic gas volume obligation of 5,064 PJ will be satisfied by the end of 2013.
- Apache / Santos – Reindeer field: Development of the offshore Reindeer gas field and on-shore gas processing plant (called Devil Creek) is currently under construction. First gas is expected to commence from the Reindeer field by the fourth quarter of 2011 at an initial rate of 110 TJ/d²⁰ with capacity to process gas up to 220 TJ/d²¹. An initial gas sales agreement with CITIC Pacific Mining²² helped underpin this development and remaining volumes are believed to be being offered into the market by Apache / Santos.
- CITIC Pacific mining signed a Gas Sales Agreement with Apache Energy and Santos, for supply of 75PJ of gas over 7 years from the Reindeer field indexed to oil prices²³. The Office of Energy estimates the implied contract price was US\$ 7.80/GJ at \$50 oil price.²⁴
- BHPBilliton / Apache Macedon field: Project is progressing into FEED study as announced September 10, 2009 by Clough²⁵. This project may bring in up to 200 TJ/d to the WA domestic market by 2013²⁶. Marketing options have not been announced, although BHPBilliton have potential portfolio requirements for their WA mining and alumina operations.
- Griffin-Tubrigi gas production has ended and FPSO to be relocated in 2009²⁷.
- Creation of the DomGas Alliance group in 2006 in response to a serious shortage of new gas supply developments in WA. Alliance members represent around 80 percent of Western Australia's domestic gas consumption and gas transmission capacity, including smaller industrial and household users of gas. The DomGas Alliance represents natural gas users, infrastructure investors and producers in Western Australia and seek to promote security, affordability and diversity of gas supply for industry and households.²⁸
- WA domestic gas prices increasing: The WA gas market has experienced substantial gas price increases in recent years. Existing connected producers are mostly fully contracted. Development costs of new gas fields has increased substantially.²⁹ The majority of the known large gas reserves in the Carnarvon Basin are now associated with LNG projects. There are a large number of smaller gas fields in the Carnarvon Basin (i.e. below 2,000 PJ) which are not associated with LNG projects. Of this group of sub-LNG scale fields only Macedon, and Reindeer currently have initiatives to bring gas to the WA domestic market. Halyard and Spar fields have

¹⁸ ACCC Determination, "*Application for Authorisation North West Shelf Project*", July 1998, p10

¹⁹ ACCC Determination, "*Application for Authorisation North West Shelf Project*", July 1998, p10

²⁰ <http://www.apachecorp.com/Operations/Australia/Projects.aspx>

²¹ <http://investor.apachecorp.com/releasedetail.cfm?ReleaseID=409139>, "*Groundbreaking signals commencement of new WA domestic gas hub*", September 15, 2009.

²² <http://www.reuters.com/article/pressRelease/idUS91169+06-Jan-2009+PRN20090106>. 06 Jan 2009.

²³ Santos Media Release, "*Santos signs US\$585 million Sino Iron gas supply contract*", 7 Jan 2009

²⁴ Office of Energy (WA), "*Gas Tariffs Review Interim Report*", June 2009, p15.

²⁵ Clough ASX Media Release, "*US\$12m study for Macedon Gas Development*", 10 September, 2009,

²⁶ The Australian, "*BHP may fast track Macedon to supply gas*", 22 November, 2008

²⁷ Upstream, "*BHP calls it a day at Griffin*". 24 July, 2009.

²⁸ <http://www.domgas.com.au>

²⁹ Australian Energy Regulator, "*State of the Energy Market 2008*", p 244

potential commercial reserves that are most likely to be developed through the existing Apache / Santos owned Varanus Island processing facilities. The remaining known fields are too marginal or remote to justify for independent gas connection or processing facilities.

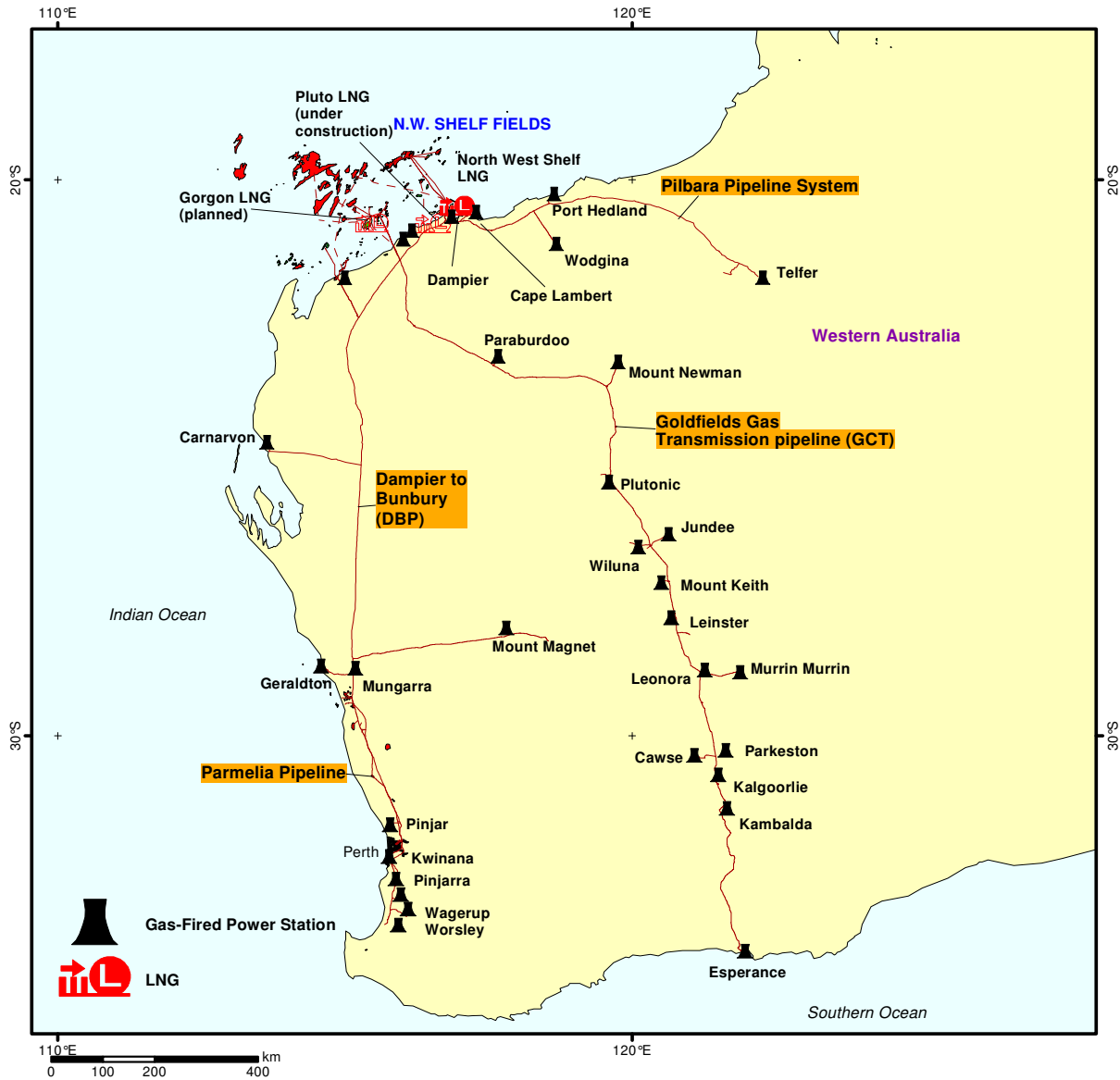
- WA's Upstream cost to produce gas are rising: In August 2007, Woodside Energy's Keith Spence advised the Australian Institute of Energy that the cost of future WA gas developments would be increasing due to:
 - Gas being located further off-shore in deeper water, requiring significant more infrastructure
 - New gas fields being found now are typically lower in condensate (requiring the gas sales to bear the full cost of field development), and
 - Gas is typically higher in carbon dioxide or nitrogen, requiring additional processing.³⁰

³⁰ Keith Spence, Woodside Energy Ltd, "*Gas supply to Western Australia*", 15 August, 2007

Section 5: Gas Transportation Options

This sections provides a summary of the existing WA gas transmission lines and stated capacities, contracted and available capacities and services available. Additionally we have made comments as to process and ease of access, process and timeliness of expansions and other relevant gas transportation assessment information. The major WA gas transmission lines can be seen on the following Wood Mackenzie map.

Figure 19 WA gas transmission lines



Source: Wood Mackenzie

Reference Point – WA Gas Transportation in 1998

The 1998 ACCC determination made references to the four primary WA gas transmission lines at the time:

- Dampier to Bunbury Natural Gas Pipeline (DBNGP) – 1,540 km
- The Parmelia Pipeline – 416 km
- The Goldfields Gas Transmission Pipeline (GGT) – 1,380 km
- The Pilbara Energy Pipeline – 237 km

Concerning regulation and access, the ACCC 1998 determination commented that “WA will establish a State based Independent Gas Pipeline Access Regulator to regulate all intra-state gas transmission and distribution pipelines under the National Third Party Access Code for Natural Gas Pipelines Systems (the national Access Code).

The DBNGP was covered through privatisation (March 1998) by a transition access regime compliant with the National Access Code until 1 January 2000 when a new access arrangement was to be put in effect under the National Access Code. Existing shipper contracts were grandfathered with the option of accepting the new access terms and conditions.

Both the GGT and Alinta Gas distribution system were to comply with access arrangements compliant with the National Access Code from 1 January 2000.

Update – WA gas transportation in 2009

There is greater transparency now in the WA pipeline sector. The two major gas transmission lines in WA – the DBP (previously called DBNGP), and the GGT are now regulated by the Economic Regulation Authority (ERA). Regulatory jurisdiction for the gas pipelines in WA come under the Gas Pipelines Access (WA) Act 1998, which follows the National Third Party Access Code for Natural Gas Pipeline Systems (the Code). Access Arrangements must provide a number of key reasonable and transparent provisions including:

- A reference tariff for all services;
- Ability for a shipper to obtain only the services required;
- Capacity trading provisions not requiring the pipeline operators consent;
- Standard Terms and Conditions for services;
- Policies for trading capacity without the pipeline operators consent;
- Queuing policy for prospective users;
- Policy on expansion and extension policies

In summary the DBP and GGT are now “covered pipelines” with reference services published and available. The DBNGP has a Standard Shipper Contract was prescribed by the ACCC pursuant to S87B Undertakings and sets out all terms and conditions offered to all shippers. The DBP is also compelled to expand its pipeline capacity for shippers under certain conditions (including a minimum of 10TJ/d and other conditions)³¹. The clarity and transparency of access arrangements for both pipeline has improved from 1998, and can be summarized as being comparable to other well developed gas market pipeline systems.

Substantial investment in gas transmission infrastructure has occurred since 1998, mostly on the DBP, as seen on the following table:

Table 6 Recent WA Gas Transmission Expansions

	Invested \$ million	Year	Owner	Comments
DBP				
Stage 3A expansion	\$130	2000	Epic Energy	Wood Mackenzie estimate
Stage 4 expansion	\$430	2006	Alcoa / B&B / Duet	/1 200 km looping, 8 compressors, complete 06/06
Stage 5A expansion	\$660	2008	Alcoa / B&B / Duet	/1 570 km looping, complete 03/08
Stage 5B expansion	\$690	2010	Alcoa / B&B / Duet	/2 440 km looping, Compressor mods, target late '10
GGT - extension	\$45	2004	ANZ Infrastructure WorleyParsons	/3 Kambalda to Esperance Pipeline
PPS - Telfer lateral	\$114	2004	APA Group	/3 Port Hedland to Telfer Goldmine

Source: ¹ DBP website: <http://www.dbp.net.au>

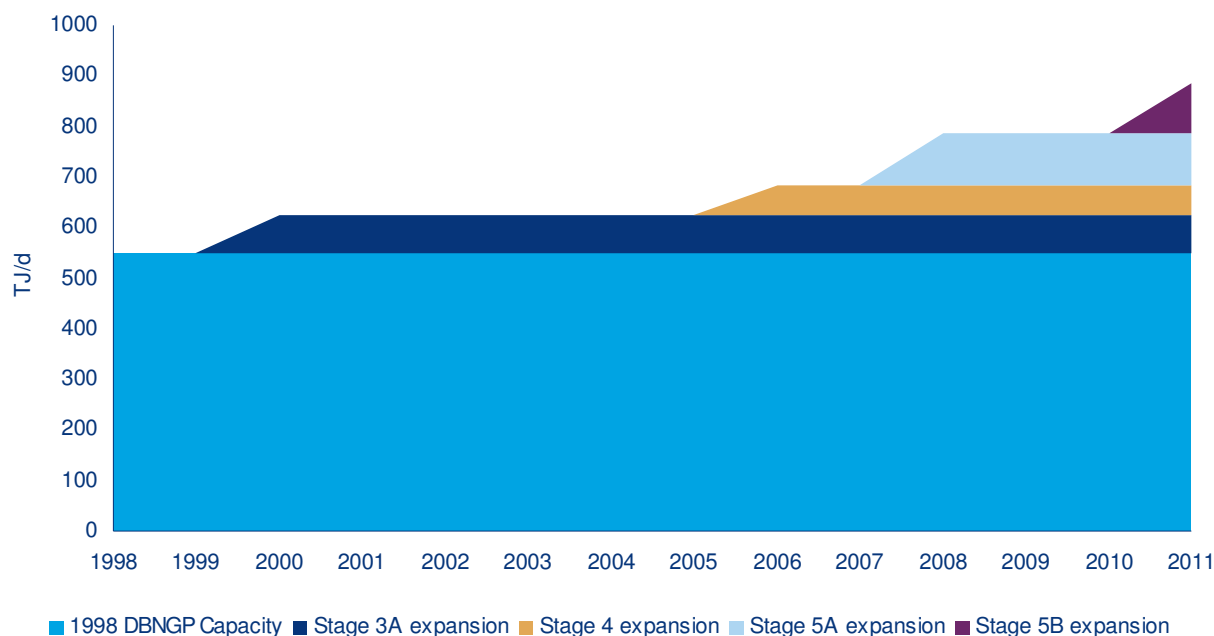
² DBP Submission to ACCC in Respect to Gorgon Gas Project, 4 June 2009

³ Australian Energy Regulator, *State of the Energy Market 2008*, p266

³¹ Gorgon ACCC Application, “Submission from DBNGP (WA) Transmission Pty Ltd”, 5 June 2009, p5.

The most material enhancements to gas transportation capacity to WA domestic customers during 1998 to 2009 were through several expansions of the DBNGP. Capacity of the DBNGP has been increased from approximate 505 TJ/d in 1998 to a current estimated capacity of 785 TJ/d, with plans for an additional expansion (5B) to lift the DBP capacity to 840 TJ/d in 2010. The growth in DBP capacity can be seen in the following graphic:

Figure 20 Dampier to Bunbury Pipeline Capacity 1998 – 2011 est.



Investment in major gas transmission pipelines in WA during the period 1998 to 2009 was significant (over \$1 billion), however, little capacity is available – as can be seen in the following table.

Table 7 Available WA Gas Transmission Capacity

Pipeline	WA Pipeline Capacities (TJ/d)			Owner	Comment
	1998 est.	2009 est.	Available		
Dampier Bunbury Pipeline (DBP)	505	785	0	DBP Consotium	5B to add 55TJ/d by 2010 end
Goldfields Gas Transmission (GGT)	130	150	4	APA, B&B	constructing 2 compressor stations
Pilbara Pipeline System (PPS)	186	186	~10	Epic Energy	Near fully contracted until 2013
Parmelia Gas Pipeline	65	65	20	APA	APA comments on capacity
Kalgoorlie to Kambalda Pipeline		20	0	Southern Cross P/L	Wood Mackenzie estimate
Mid West Pipeline		20	10	APA	Wood Mackenzie estimate
Telfer Gas Pipeline		25	0	APA	Wood Mackenzie estimate
Kambalda to Esperance Pipeline		6	0	Esperance Power	Wood Mackenzie estimate

Sources: <http://www.ggt.com.au/>
<http://www.dbp.net.au>
<http://www.epicenergy.com.au>
<http://www.apa.com.au>
 Office of Energy, Relevant websites

Beyond the major expansions on the DBP, the last ten years have seen construction of a 486 km lateral off of the PPS Pipeline system near Port Hedland connecting the Telfer mine (488 km). A small spur line was then built off of the Telfer extension connecting the Nifty mine.

Additional activity in the WA gas transmission sector since 1998 includes the GGT pipeline being extended from Kambalda to Esperance.

Changes to the gas quality specifications requirements for DBNGP gas has seen some improvement through the removal of the LPG content requirement of 1.45 Tonnes/TJ. This original gas specification requirement was in place to support the extraction of LPG in Kwinana by Wesfarmers which helped develop that industry in Western Australia. This contractual requirement has expired and the DBP proceeded to lower this gas quality specification in 2005³². This change is positive in enabling lower liquid content gas supplies to be connected to the DBNGP.

Debate continues on the further alignment of the DBNGP gas specifications to National Standard AS 4564. The thrust of this initiative comes from BHP Billiton who seeks to bring their Macedon gas field into production for the domestic market while acknowledging that their gas field will not meet the heating value requirement of the DBP.³³ The debate revolves around some safety concerns with broadening the DBNGP specs to AS 4564 values, as well as the effective loss of DBNGP capacity by accommodating the lower heat content Macedon gas.³⁴ This issues is not yet resolved, however, Wood Mackenzie believes there are commercial solutions possible between the DBP and BHPBilliton to enable the blending of the Macedon gas. Such commercial arrangements were in place previously between BHPBilliton and the DBNGP to accommodate the continued receipt of out of specification Griffin-Tubridgi gas once the operation of related gas processing plant become uneconomic.

The DBP now offers a Park and Loan service which assist shippers in balancing their imbalances. The DBP one way Park and Loan service allows daily volumes of not less than 1TJ/d and monthly volumes of not more than 10TJ/d per shipper contract³⁵.

The DBP also allows imbalances of up to 20% of the daily contracted MDQ, which is to be resolved upon notice with best efforts. Additionally, the DBP allows hourly imbalances of up to 140% of the hourly proportion of the daily MDQ³⁶. This flexibility is helpful to some shippers who require a large amount of gas for a few hours followed by no gas demand in subsequent hours. As long as 125% percent of the hourly allotments are not exceeded and the overall daily imbalance is within 20% of the MDQ, there is no concern from the pipeline operator.

Concerning the GGT, the ERA reports that shippers advise the GGT displayed flexibility and “give and take” in negotiations of shipper contracts.³⁷ Shippers are required to ensure that accumulated imbalances are below 1TJ or 8 percent of the maximum daily quantity, and must make all reasonable efforts to maintain an accumulated imbalance of zero.³⁸ The GGT will expand only when underwritten by customer contracts – which is normal for capital intensive utility type businesses.

Summary of changes in the WA gas transmission scene

- Gas transmission capacity has been materially increased in WA since 1998 primarily due to expansions on the DBP.
- Introduction of an open access regime for the DBNGP. This access regime, in place until 2016, compels the DBP owner to expand the pipeline provided appropriate client undertakings for such.

³² ERA, “*Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline*”, November 2005.

³³ Application for Revocation of Pipeline Coverage under the National Access Code for Natural Gas Pipeline Systems – Tubridgi Pipeline (PL 16) and Griffin Pipeline (PL 19) BHPBilliton 28 October 2005.

³⁴ McLennan Magesanik Associates, “*Report to the Joint Working Group on Natural Gas Supply*”, 16 July, 2007.

³⁵ “*DBP Park and Loan Service Term Sheet*”. Available at: www.dbp.com.au

³⁶ ERA, “*Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline*”, November 2005. www.dbd.net.au, p65.

³⁷ Economic Regulation Authority, “*Discussion Paper: Gas issues in Western Australia*”, June 2007.

³⁸ Goldfields Gas Transmission Ptl Ltd, “*Approved Access Arrangement, Appendix 3 – to set an accumulated imbalance to zero, General Terms and Conditions*”, 2005, p11ff.

- Access to new customers has been enhanced in WA since 1998 through the expansion of the DBP capacity, extension of the GGT from Kambalda to Esperance, and laterals off of the PPS pipeline to mine sites at Wadgina, Telfer, and Nifty.
- Little spare pipeline capacity is available to WA's primary gas markets due to the DBP and GGT pipelines remaining nearly fully contracted.
- The Parmelia pipeline has approximately 20 TJ/d of spare capacity, however, its main supply basin – the Perth Basin – continues to experience declining production, causing this available transmission capacity to have little use to serving the markets needs. The Parmelia pipeline can, however, receive gas from the DBP pipeline, yet that pipeline remains fully contracted.
- In December 2006 an interconnect was installed between the DBP and GGT³⁹ allowing the GGT customers the opportunity to source gas from all DBP suppliers (primarily NWSP) rather than from only the Varanus Island connected fields.
- DBNGP proposed revised Access Arrangement in 2005 dropped the minimum LPG content requirement (previously required to be 1.45 tonnes /TJ)⁴⁰. This change brings the DBP gas quality requirements closer to the national gas standard (AS 4564) in regard to LPG content which will be helpful in accommodating lower liquid content gas fields.

³⁹ <http://www.dbp.net.au>

⁴⁰ ERA, *“Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline”*, November 2005.

Section 6: Gas Storage Options

In this section Wood Mackenzie has reported on the known gas storage alternative in WA which is at Mondarra, managed by APA. Comments are also made as to expected capability of these facilities as well as potential other alternatives. Investigation were made into other potential storage sites in the Perth Basin and qualifying comments are made as to the market support needed, and likely investment required to realize and expand these alternatives.

Current status of WA gas storage options

Mondarra storage, sponsored by APA is currently the only traditional gas storage opportunity in the WA gas market. Mondarra is a fledgling gas storage operation built upon a depleted Perth Basin gas reservoir. APA advise Mondarra storage field has current functionality of approximately 12 TJ/d injection and 12TJ/d outlet⁴¹. The current capacity is believed to be contracted to Verve Energy⁴². APA is currently soliciting interest in a Stage 1 enhancement of Mondarra facility which could see capacity increased to approximately 35 TJ/d injection and 70 TJ/d withdrawal capacity. APA further advise that a Stage 2 expansion may be offered in time increasing their facility capacity to 70 TJ/d injection and 140 TJ/d outlet capacity.

Another form of indirect gas storage is through the use of a Park and Loan service with the DBP. Large gas transmission lines require substantial amounts of "line pack" to fill their pipelines. Given the substantial amounts of gas required to fill these pipelines and the flexibility possible in particular from having multiple in-line compressor stations, operators often have the ability to offer Park and Loan services which is in effect storage services. Park and Loan services on a pipeline allow parties that have contracted these services a mechanism to help manage the uncertainties of their market demand for gas and the limitations of their available supply. The DBP currently offer a Park and Loan Service. It is Wood Mackenzie's understanding that the current DBP Park and Loan service offered by the DBP requires settlement of any outstanding balances on a monthly basis, settled either by in kind (physical molecules) or by payment in cash.

The major pipelines each have gas balancing provisions which allow some day to day imbalances to be managed by the pipeline, however, these provisions are limited and strongly written to the advantage of the pipeline operator who must maintain integrity of the pipeline as a priority. Gas balancing at the seller or buyers request will always be subject to the discretion of the pipeline operator, such that make up volumes cannot always be relied upon given pipeline integrity and safe operations are the first priority. On the DBP, imbalances are limited to 8% of the shippers daily capacity entitlement, and are to be resolved daily⁴³. The GGT has the right to trade out imbalances which have occurred over the past 7 days, under punitive terms.⁴⁴

Park and Loan services and pipeline balancing provisions do provide shippers with some volume flexibility however, these volumes are small and physical molecules are required in order to manage these imbalance positions or risk exposure to punitive payments.

Summary of change in WA gas storage:

The Mondarra gas storage fields currently offers some very modest levels of gas storage – i.e. 12 – 15 TJ/d inlet and outlet capability (<2% of the total average daily market volume). Mondarra holds promise to become a much more significant gas storage facility in the future potentially to 70TJ/d (~8% of the total average daily market volume) outlet and 35 TJ/d inlet, however, will require customer or sponsor contracts and investments to be expanded. Further expansions of storage capacity would be possible at Mondarra as well as other gas fields in the Perth Basin.

⁴¹ Office of Energy, "Information Update", 25 June 2008

⁴² Concept Economics, "Marketing of Natural Gas in the Western Australian Domestic Gas Market", Dec 2008, p 8.

⁴³ <http://www.dbp.net.au> "Dampier to Bunbury Natural Gas Pipeline, Full Haul T1 Contract Terms & Conditions".

⁴⁴ Concept Economics, "Marketing of Natural Gas in the Western Australian Domestic Gas Market", Dec 2008, p 27.

Section 7: Activities of Gas Brokers / Aggregators

In this section Wood Mackenzie has investigated both public reference material as well as relevant party interviews to provide on the availability and depth of gas brokers and aggregators in the WA market. Where appropriate Wood Mackenzie may have discrete interviews to better understand and report on the viability, growth or key issues with this sector.

Reference point – WA brokers / aggregators in 1998

The 1998 ACCC determination cited that secondary markets in WA were undeveloped, however, implied they were likely to arise due to gas industry deregulation (customer contestability) and growing demand in WA.⁴⁵

Current status – WA brokers / aggregators in 2009

Gas aggregation and brokering in WA have progressed materially since 1998 yet is still considered immature. There are now four established businesses providing gas brokering and aggregating services, a quasi brokering service now being offered by WA's largest gas transmission pipeline, and two smaller start up gas brokering / aggregation / scheduling businesses.

There four established business offering gas brokering and aggregation services to the WA gas market are;

- o Alinta,
- o Synergy,
- o Verve Energy, and
- o Perth Energy⁴⁶.

Alinta is the most sizeable of these gas aggregators / brokers and retailers. Wood Mackenzie estimates Alinta currently manages approximately 170 TJ/d of gas sales serving a variety of residential, commercial and industrial customer needs. Wood Mackenzie understands that Alinta does manage some gas sales and transportation requirements of others, however, their primary focus is managing their own gas sales. Alinta was acquired by Babcock and Brown Power in May 2007.⁴⁷

In April 2007 WA's electricity retailer Synergy applied for a gas trading licence, however, Synergy are restricted from supplying gas to customers who consume less than 0.18 TJ per year.⁴⁸ Synergy does currently provide a daily gas trading and aggregation service, however, Wood Mackenzie understands the total volume and transaction count on a daily basis are very small.

Perhaps the most material aggregation and brokering of gas in WA is via the DBP's "Inlet Trades" service. The DBP pipeline is also currently offering a capacity trading, aggregation service to help shipper manage the gas supply and imbalance needs. The DBP's system called "Inlet Trades" is managed within the DBP's CRS (Customer Reporting System) which does limit this service to the shippers of the DBP, which are nonetheless the majority of the gas sellers and buyers in WA. The scale of transactions accommodated by the DBP service is believed to be in the range of 50 – 70 TJ/d in the peak summer season and 10-20 TJ/d in the off-season.⁴⁹ Inlet trades is believed to accommodate gas sales and exchanges, capacity trading, imbalance exchange, and spot sales. However this service currently lacks transparency and it is difficult to gauge the real depth and liquidity associated with these transactions.

⁴⁵ ACCC Determination, "Application for Authorisation North West Shelf Project", July 1998

⁴⁶ Australian Energy Regulator, "State of the Energy Market 2008", p35

⁴⁷ Australian Energy Regulatory, "State of the Energy Market 2008", p297

⁴⁸ ERA, "Decision on gas trading licence application for Synergy (Electricity Retail Corporation)", 26 June 2007.

⁴⁹ Gorgon Gas Project, "Submission to the ACCC in Response to Third Party Submissions Regarding the Application for Final Authorisation", 31 July 2009. p4

Additionally, two new gas brokering / aggregation services have appeared in the WA gas scene which are understood by Wood Mackenzie to offer a suite of gas brokering, trading, and imbalance services:

- Melsim Consulting Pty Ltd
- Mike Lauer's Gas Trading Australia Pty Ltd, and

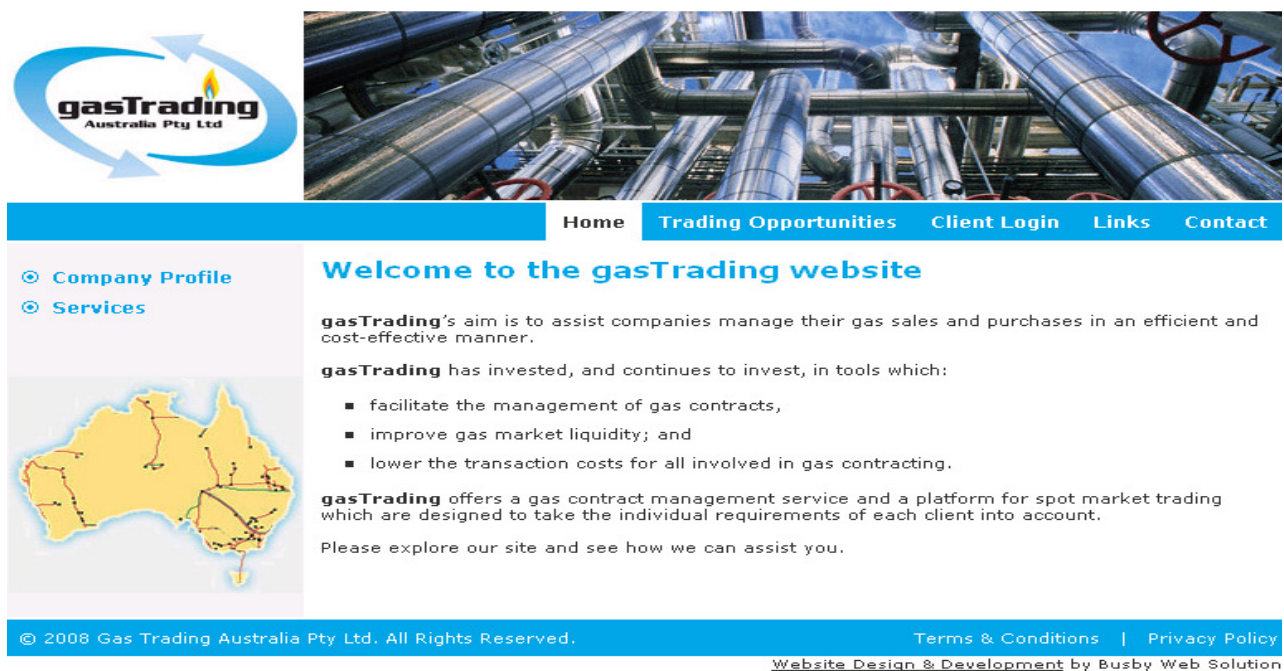
Melsim Consulting is understood by Wood Mackenzie to be facilitating gas aggregation, trading, and scheduling for smaller gas buyers on the WA gas transmission systems. Volume of daily business is believed to be in the range of 5 and 15 TJ/d. Melsim Consulting Pty Ltd is led by Thomas Melsim and does not have a website.

Gas Trading Australia Pty Ltd is led by Mike Lauer and offers the following services:

- Spot gas sales – purchases and deliveries
- Short term sales (with and without transportation)
- Pipeline capacity trading (interruptible)
- Pipeline Imbalance swap and allocation
- Standard terms gas supply

gas Trading's website is www.gastrading.com.au can be seen below.

Figure 21 gasTrading Website



General lack of both spot gas supply as well as lack of interruptible pipeline capacity has limited the environment for gas brokers and aggregators in WA. It is extremely difficult for a new entrant participant to trade in gas without contracting both supply and pipeline capacity. As such, the current trading is predominantly between existing participants with contracted pipeline capacity.

Summary of change in WA gas brokering and trading:

There has been modest progress in this area with a number of entities now offering these services, however, the overall daily volume of such transaction is believed to be 70 TJ/d or less (<8% of the total average daily market volume). From a broader perspective, WA is still an immature gas trading market with the limited volume, and limited number of counterparties actively participating resulting in no effective liquidity.

Section 8: Existence of Gas Related Financial Markets

Current Status – gas related financial markets

No gas related financial markets or instruments have evolved in WA. This is attributable to a number of reasons including;

- the lack of transactions and counterparties due to a high concentration of both sellers and buyers;
- The WA gas market being comprised of long term, Take or Pay type Gas Sales Agreements as well as Gas Transportation Agreements;
- Lack of gas storage or a means of trading imbalances;
- Existence of penalty provisions for not managing pipeline gas imbalances on a daily basis;
- The two primary arterial gas transmission lines in WA (the DBP and the GGT), being fully contracted providing little opportunity for short term or spot transactions to be consummated.
- Lack of day trading and population of counterparties to generate liquidity.

For gas related financial markets to develop, a transparent spot and trading exchange needs to be developed.

Summary of change in WA gas related financial markets

There has been effectively no change in this area – no gas related financial markets exist in WA.

Section 9: Existence of Short Term and Spot Market Sales

Current Status – WA short term and spot market sales

Short term and spot markets for gas are occurring now in WA in a number of ways, however, from an comparative perspective to other vibrant spot markets, WA is still immature and developing.

Gas suppliers have been offering some short term gas supplies and spot sales⁵⁰. Overall volumes are understood to be limited. Short term and spot trading within WA are also occurring within the gas brokering and trading dealings of Alinta, Synergy, Verve, Perth Energy, and GasTrading. As mentioned in Section 7, perhaps the most material platform for short term and spot trading is the DBP's "Inlet Trades" service which operates as a part of the DBP's CRS system (a DBP client system which facilitates trading and brokering of gas and transportation capacity).

One unsuccessful initiative to foster a short term and spot trading market was initiated by the WA government. In response to the Varanus Island explosion, and highlighting the illiquid nature of the domgas trading market and lack of spot trading or suppliers, the IMO developed a Gas Bulletin Board (GBB) in response to the frustration experienced by the gas industry and gas consumers over the allocation of natural gas. The Varanus Island explosion disrupted approximately 30% of the state's gas supply. During this period, the GBB provided a platform for Western Australia's gas industry to facilitate the contracting of natural gas between buyers and sellers.

The Electricity Industry (Independent Market Operator) Regulations 2004 were amended on Friday 27 June 2008 to allow the IMO to operate the GBB. On Monday 30 June, 2008, a Services Agreement for the Gas Bulletin Board was executed with the Office of Energy. The GBB commenced operation on Thursday 3 July 2008. Services were provided by the IMO on a cost recovery basis. The minimum trade quantity for the day ahead was set initially at 0.5 TJ and later lowered to 0.1 TJ/d.

A total of 27 traders registered and 14 traders were active in submitting bids, resulting in 9 traders being successfully matched with sellers. All matches made on the GBB were priced between \$15.50 and \$18.50/GJ⁵¹. As a result of the partial resumption of natural gas supplies from Varanus Island, and no gas being offered for sale on the GBB since the 29 August 2008, the IMO recommended to the Office of Energy that the GBB be closed down. This recommendation was accepted and the GBB ceased operation on Monday 13 October 2008.⁵² The IMO GBB facilitated 32 matched gas trades for a total volume of 47.8 TJ.

Overall the Western Australia gas market still lacks a transparent and liquid spot market in which gas purchasers or new entrant companies can rely on to source their gas supply needs

Summary of change in WA short term and spot gas sales

Short term and spot sales are understood to be occurring in WA as the result of several individual companies efforts, including "Inlet Trades" by the DBP pipeline to its customers which accommodates both gas supply and capacities needs and imbalance exchanges. Short term and spot sales transactions are not organized in any open readily accessible forum. The WA spot market is very modest and considered immature.

⁵⁰ Gorgon Determination. "Submission from Alcoa, 8 June 2009, p5-6., Submission from Synergy", 9 June 2009, page 3.

⁵¹ IMO, "Gas Bulletin Board Report", <http://www.imowa.com.au>

⁵² <http://www.imowa.com.au>

Section 10: Identify Changes in the WA Gas Market

In Wood Mackenzie's view, the key changes in the WA gas market since 1998 include the following:

- **Material expansion of the DBP and extension of the GGT**
- **Offering of Mondara Gas Storage service**
- **Domestic Gas Reservations directive**
- **Contestability of gas customers**
- **Heightened awareness of the vulnerability of the WA gas market to gas supply interruption due to Varanus Island explosion**
- **Change in the proximity and quality of gas available for domestic gas use**
- **Change in the cost to explore, develop, produce and process gas for the domestic gas market**
- **BHPBilliton Worsley Alumina expansion based on construction of a coal fired boiler rather than gas fired**
- **Substantial new build of coal fired power generation**
- **Export competition for gas resources.** The LNG business has become a bonanza for Australia. In the last 10 years there has been a significant increase in regional and global LNG demand, which when coupled with limited LNG supply and increasing oil prices led to a significant increase in LNG pricing. Before the Global Financial Crisis, the Pacific Basin LNG market looked to be a sellers market for many years to come due to limited supply, driving LNG prices to parity with oil on a \$/mmbtu basis. Many producers maintain a long term view that gas will be the premium fuel for the 21st century given its clean energy qualities relative to oil and coal and will continue to be priced near or even above oil parity into the future. Producers are also attracted to the significant scale which can be achieved in LNG projects. For example a minimum field size to underpin a modest size LNG project (e.g. 3.5 Mtpa) for a 20 year term would require a gas field of approximately 4 Tcf. WA has many such gas fields of this size and larger. Regional and global LNG markets are of such a size that multiple LNG trains can be added to projects allowing even greater scale to be achieved. The attractiveness of both scale and oil indexed pricing which can be achieved through LNG projects results in the consideration of sales into the WA domestic market unappealing by comparison.

Section 11: Likely Future Market Development

Gas demand in WA will likely continue to develop in “lumps” or stair steps due to the necessary simultaneous alignment of:

- Gas demand – (each significant new end-user – e.g power plant, industrial users, mine site)
- Gas transportation capacity between the gas supply point and the end-users delivery point
- Mid-stream gas processing capacity (to clean up the raw produced gas to pipeline quality specifications)
- Upstream gas supply

As each of these necessary components are significant undertakings in themselves, the alignment of all four components to a stage where gas supplies are actually flowing, requires a significant amount of coordination and contracting.

The WA gas market is comprised of several end-use categories (Alumina, Retail (commercial / industrial), Mining and Power Generation) which each have differing gas price sensitivities, fuel alternatives and competitive pressures. Mining and Power Generation sectors are likely to see the most significant growth in gas demand. In aggregate, the overall demand for gas in WA is expected to rise materially in the next 20 years.

Gas supply available for the WA gas market should likely increase provided the existing and probable LNG projects are completed and their domestic gas obligations are actually made available to the WA gas market. These prospective gas supply points will be important in increasing supply competition as well as supply security for the Western Australia gas market

WA proposed LNG projects will face strong competition for market and may constrain timely development of these prospective projects. Each LNG project must compete for and secure regional or globally markets to become a reality. Obviously not all projects will be successful in which will cause their related domestic gas components to also not materialize. Appendix 2 provides details on the known Australia / PNG LNG projects (including existing, probable, possible and speculative) as of September 2009. There are currently two existing projects (NWSP, and Darwin LNG), with two other committed projects (Pluto and Gorgon), and 28 other proposed LNG projects for Australia and PNG.

With the development of Devil Creek (under construction), the proposed domgas developments associated with Pluto and Gorgon LNG projects and the possible development of the Macedon gas field, the outlook for new domestic gas supplies in the medium term (2015/16) looks encouraging. These developments will introduce new supply points to the market, increasing competition and volume into the market. Further potential exists with the proposed Wheatstone LNG project (and its associated domgas plant).

The introduction of new supply points opens the possibility for the market to move to a more liquid environment for supply. From a producers perspective, it is possible the requirement for long term contracts to underpin investment may be less important than it has been in the past as the incremental investment of domestic gas plants is significantly less than the overall cost of the new LNG project under development. Producers may therefore be willing to sign short to medium term contracts which will help improve the overall liquidity in supply contracting.

In Eastern Australia the Australian Energy Market Operator (AEMO) is in the process of implementing a Short-term Trading Market (STTM) targeting commencement in June 2010. The initial trading hubs will be in Sydney and Adelaide and is intended to provide transparency in market pricing, yield price signals for consumers and investors in pipe, pipeline services, storage and supply. The overall aim is to enhance market liquidity by allocating gas to the parties that value it the most. The STTM will establish a mandatory price-based balancing mechanism for all gas delivered to or withdrawn from defined market hubs.

The WA Gas Market Development Working Group recently recommended that based on the high cost of design, analysis and implementation of a STTM for WA⁵³ that WA should not proceed with a STTM at this time. The Working Group recommended that a review of the value of the STTM be undertaken following one year of operation of the AEMO STTM has occurred in Eastern Australia. Therefore development of any possible STTM in Western Australia is unlikely to be operational before 2012 at the earliest. However the Gas Working Group has recommended the establishment of a

⁵³ http://www.energy.wa.gov.au/2/3260/64/gas_supply_and_.pm Gas Market Development Working Group - Western Australia Gas Market Developments Final Report – Marchmont Hill Consulting 10th September 2009.

permanent Gas Bulletin Board (GBB). A GBB will help provide information that could be used to identify potential trading opportunities which may allow interested parties to commence commercial negotiations. However, it falls short of a trading market that yields transparent pricing signals for market players.

Material development of a spot market is therefore unlikely to develop in Western Australia before substantial new gas supply comes into the market around 2015/16 and further progress is made in increasing transparency of price and volumes traded.

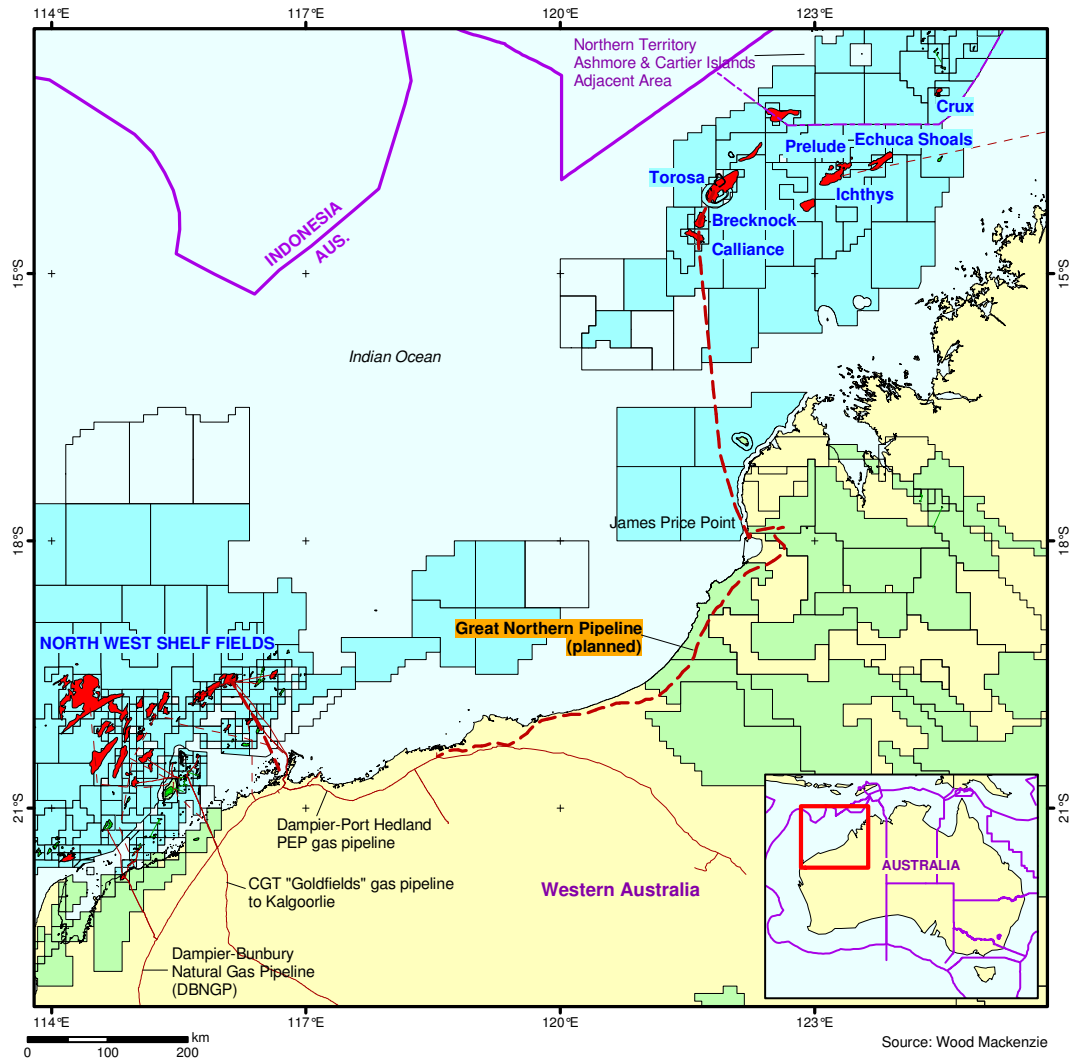
Section 12: Other Impacts to WA Gas Market Competition

There are a number of other considerations which Wood Mackenzie suggests are relevant to the WA gas market competitive assessment. Rather than focus purely on competition among gas suppliers, we believe it is relevant to be aware of other market dynamics which also have impact on the overall competitiveness and growth of gas sales in WA.

Development and Connection of Browse Basin gas fields WA Pipelines

The Browse Basin continues to delight explorers with large discovered gas resources – the known fields can be seen in the following map.

Figure 22 Browse Basin Gas Fields and Proposed Great Northern Pipeline



Browse Basin gas export projects will be subject to the WA domestic gas reservation policy similarly to the Carnarvon Basin fields (ex. Pluto and Gorgon). Once a project is built on-shore, there is the prospect that the AWE proposed Great Northern Pipeline could be utilized to connect these gas resources to the main arterial pipelines feeding the WA gas markets. As the timing of any of these land based LNG export projects as well as the Great Northern Pipeline are unknown, the impact of these gas fields on the WA gas market competitiveness can only be speculated on. In theory these additional gas supplies should enhance the WA gas market supply competitiveness. These gas supplies will have the added cost of transportation down the Great Northern Pipeline. Given the tyranny of distance, the cyclonic nature of the Kimberly and Pilbara and the pipelining challenges which that presents, the Browse Basin producers may pursue gas swapping or exchanging arrangements with Carnarvon basin producers to satisfy their domestic gas obligation.

Decision from the NWSP to renew / rollover domestic gas supply contracts

As mentioned in Section 4, Wood Mackenzie estimates that the NWSP original SECWA domestic market obligation to provide 5,064 PJ will be satisfied during 2013. Wood Mackenzie estimates the NWSP has provided approximately 570 TJ/d to the domestic market for both 2008 and estimated 2009. The consequences of NWSP not continuing those domestic gas sales in whole or part, would have a profound impact on the WA domestic gas situation. If the NWSP didn't continue supplying at least 300-400 TJ/d of future domestic gas sales volumes, it is Wood Mackenzie view that the WA domestic gas market will be materially undersupplied and of risk to disruption in the medium term. The additions of prospective supply from Apache's Devil Creek gas, Pluto domestic gas and Gorgon domestic gas, as well as Macedon's gas may likely not be enough serve the WA domestic gas demands. No other material gas volume projects (i.e. providing +50TJ/d for medium or long term contracts) are seen in the 5 – 8 year future.

Timing of actual first domestic gas from Gorgon and Pluto

Gorgon's commitment to provide domestic gas is now targeted by the end of December 2015. A project of this scale will certainly be vulnerable to delays.

Pluto's commitment to the domestic gas market may be as late as 5 years after first LNG⁵⁴.

Delays in the timely delivery of domestic gas from either of these LNG projects may be likely given the scale of these projects.

Coal Power Generation growth – due to the rising cost of gas and the unavailability of gas, the majority of the most recent announced planned and proposed power generators will be fuelled by coal.

Power sector limitation on volatile price pass through. Gas sales to the power sector may be limited due to both competition (with coal) as well as the inability to pass through price volatility which results from indexation of the US\$ or oil price. As evidenced by the CITIC Pacific announced GSA with Apache / Santos for Devil Creek gas, the related gas price was referenced as both US\$ denominated and linked to oil price. It is Wood Mackenzie's understanding that the current WA electricity bidding process for securing capacity certificates from the IMO cannot tolerate this sort of open ended future price volatility. Should producers require future gas sales prices to be linked to US\$ and oil indexation, (which is similar to LNG sales), gas purchases and related demand from mid-merit and peaking power generators may be lost.

Upstream costs of gas likely rising: WA's Upstream cost to produce gas are rising: In August 2007, Woodside Energy's Keith Spence advised the Australian Institute of Energy that the cost of future WA gas developments would be increasing due to:

- Gas being located further off-shore in deeper water, requiring significant more infrastructure
- New gas fields being found now are typically lower in condensate (requiring the gas sales to bare the full cost of field development), and
- Gas is typically higher in carbon dioxide or nitrogen, requiring additional processing.⁵⁵

54

<http://www.mediastatements.wa.gov.au/ArchivedStatements/Pages/CarpenterLaborGovernmentSearch.aspx?ItemId=129601&minister=Carpenter&admin=Carpenter&page=3>, 4 November 2008.

⁵⁵ Keith Spence, Woodside Energy Ltd, "Gas supply to Western Australia", 15 August, 2007

Appendix 1 - Carnarvon Basin Retention Leases

Carnarvon & Perth Basins Gas Resources (PJ)

Field Name	Produced	Remaining Contracted	Uncontracted	Total	Block Name	Lease Expiry Date
Fields Over 2000 PJ						
Greater Gorgon Commercial	0	24,995	0	24,995	multiple (Gorgon)	multiple (Gorgon)
Greater Gorgon Technical (less West Tyrall Rocks)	0	0	21,535	21,535	multiple (Gorgon)	multiple (Gorgon)
NWS Gas Project	13,207	19,328	701	20,029	multiple (NWS)	multiple (NWS)
Scarborough	0	0	10,600	10,600	WA-1-R	01/02/2010
Wheatstone/Iago	0	0	9,086	9,086	WA-253-P	29/06/2013
Wheatstone/Iago continued					WA-17-R	01/10/2007
Wheatstone/Iago continued					WA-16-R	22/08/2007
Clio	0	0	6,890	6,890	WA-205-P	20/12/2011
Clio continued					WA-374-P	24/01/2012
Clio continued					WA-392-P	18/02/2013
Pluto/Xena	0	4,684	618	5,301	WA-34-L	07/08/2107
Julimar Area	0	0	3,816	3,816	WA-356-P	19/06/2011
Thebe	0	0	3,180	3,180	WA-346-P	15/07/2009
West Tyrall Rocks	0	0	2,714	2,714	WA-5-R	28/05/2008
Subtotals = 9 Fields Over 2000 PJ	13,207	49,006	59,139	108,145		
Fields between 200 and 2000 PJ						
Briseis	0	0	1,590	1,590	WA-390-P	18/02/2013
Glencoe	0	0	1,590	1,590	WA-390-P	18/02/2013
Nimblefoot	0	0	1,590	1,590	WA-390-P	18/02/2013
John Brookes	224	988	210	1,198	WA-29-L	20/12/2104
John Brookes continued					WA-214-P(1)	24/06/2013
Macedon	0	0	691	691	WA-12-R	05/10/2008
Reindeer Area	0	74	464	538	WA 209-P	08/01/2012
Martell	0	0	530	530	WA-404-P	16/07/2013
Harriet Area	474	168	181	349	multiple producing	multiple producing
Spar	0	0	340	340	WA-4-R	28/05/2008
Wanaea/Cossack	0	0	277	277	multiple producing	multiple producing
Maitland	0	0	239	239	WA-33-R	04/04/2009
Subtotals = 11 Fields 200 - 2000 PJ	698	1,230	7,702	8,932		
Fields Under 200 PJ (under 20 PJ excluded)						
Gingin	0	0	186	186	EP 389	24/09/2009
Rivoli	0	0	159	159	EP 325	28/03/2011
Halyard	0	0	128	128	WA-13-L	18/02/2017
Corvus	0	0	127	127	WA-246-P	06/04/2011
Frankland	0	0	74	74	WA-286-P	27/06/2010
Pyrenees Area	0	0	73	73	WA-12-R	05/10/2008
Pyrenees Area continued					WA-155-P(1)	23/08/2009
Saffron	0	0	37	37	WA-1-P	28/01/2014
Flinders Shoal	0	0	28	28	TR/1	08/12/2009
Egret	0	0	22	22	WA-10-R	03/07/2009
Nasutus	0	0	21	21	EP 409	13/05/2010
Cadell	0	0	21	21	TP/7(1/2/3)	07/04/2010
Hurricane	0	0	21	21	WA-208-P	13/01/2014
Senecio	0	0	21	21	L 2 FO	17/05/2014
Enfield Area	0	0	21	21	WA-28-L	28/03/2104
Vincent	0	0	21	21	WA-28-L	28/03/2104
Subtotals = 15 Fields less than 200 PJ	0	0	961	961		
Totals PJ	13,905	50,267	67,802	118,038		

Source: Wood Mackenzie

Definition: Retention Leases are awarded for non-commercial petroleum discoveries. The applicant must demonstrate that the resource is not currently commercially viable, but is likely to become viable within the next 15 years. The initial term of a Retention Lease is five years and it may be renewed provided it still meets the required commerciality criteria. When the discovery is deemed to be commercial, the Retention Lease must be converted to a Production Licence. At any time during the five year term the government can request a review of the commercial viability of the field in the lease area.⁵⁶

⁵⁶ <http://www.dmp.wa.gov.au>

Appendix 2 - 2009 LNG Projects – Australia & PNG

Projects	Status	Capacity Mtpa	Partners
Carnarvon			
1 North West Shelf	existing	16.3	Shell, BP, BHP, Chevron, Woodside, Mimi
2 Pluto	constructing	4.8	Woodside, Kansai, Tokyo Gas
3 Greater Gorgon	constructing	15	Chevron, XOM, Shell
4 Pluto expansion	possible	(4x4.8)	Woodside
5 Wheatstone	speculative	10	Chevron, Shell
6 Wheatstone expansion	speculative	15	Chevron
7a Scarborough	speculative	5.8	BHP, XOM
7b Scarborough - FLNG	speculative	5.8	BHP, XOM
8 Greater Gorgon expansion	speculative	10	Chevron, XOM, Shell
9 Prelude - FLNG	speculative	3.5	Shell
Browse			
10 Ichthys	possible	10	Inpex, Total
11 Browse	speculative	7 - 10	Woodside, Chevron, Shell, BP, BHP
Bonaparte			
12 Darwin LNG	existing	3.35	ConocoPhillips, Santos, Inpex, Tokyo Gas, Eni, TEPCO
13a Greater Sunrise	speculative	?	Woodside, ConocoPhillips, Shell, Osaka Gas
13b Greater Sunrise - FLNG	speculative	5.8	Woodside, ConocoPhillips, Shell, Osaka Gas
14 Darwin LNG expansion	speculative	?	ConocoPhillips, Santos, Inpex, Tokyo Gas, Eni, TEPCO
15 Montara Area - FLNG	speculative	?	PTTEP, Golar LNG
16 Petrel Tern - FLNG	speculative	?	GDF Suez, Santos
17 Timor Sea LNG Project	speculative	3	MEO Australia, Petrofac
Queensland CSG			
18 Queensland Curtis LNG	probable	(2x3.7) 7.4	BG, potential increase to 12 Mtpa
19 Australian Pacific LNG	possible	(4x3.5-4) 16	Origin, ConocoPhillips
20 GLNG	possible	3.5	Santos, Petronas
21 Gladstone LNG	possible	1.5 - 3	Arrow, Golar, LNG Ltd
22 Gladstone - FLNG	speculative	1.5	Flex LNG
23 Southern Cross LNG	speculative	0.7 - 3.9	LNG Impel
24 Shell LNG (Gladstone)	speculative	(4x 4-6) 16	Shell, Arrow
25 Sojitz (Fishermans Landing)	speculative	0.5 - 1	Sojitz Corp
26 Energy World Corp - Abbot Poin	speculative	0.5 - 1	Energy World Corp
PNG			
27 PNG LNG	probable	6.3	XOM, Oil Search, Santos, Nippon, Merlin
28 PNG LNG expansion	speculative	?	XOM, Oil Search
29 Liquid Niugini Gas	speculative	3 - 5	InterOil
30 Elk Antelope	speculative	?	InterOil, PNG
31 Talisman - FLNG	speculative	1.5	Talisman, Flex LNG
32 Pandora Area - FLNG	speculative	?	Talisman, Carin, Beach, Eni, OSH, XOM, Pacrim

Appendix 3 – Carnarvon, Browse and Perth Basin Gas Resources

Basin Name	Field Name	Total Rem Resources (PJ)	Basin Name	Field Name	Total Rem Resources (PJ)
Carnarvon Basin	Antiope	11	/1 Carnarvon Basin - Gorgon Fields	Gorgon	18,295
	Blencathra	1		Io/Jansz	18,664
	Briseis	1,590		Chrysaor/Dionysus	3,586
	Cadell	21		West Tryal Rocks	2,714
	Clio	6,890		Geryon	2,530
	Corvus	127		Chandon	2,279
	Egret	22		Orthrus/Maenad	1,162
	Enfield Area	21		Total	Carnarvon Basin Total
	Errol	11	Perth Basin	Beharra Springs Area	7
	Flinders Shoal	28		Dongara Area	6
	Glencee	1,590		Frankland	74
	Greater Gorgon Commercial /1	24,995		Gingin	186
	Greater Gorgon Technical /1	24,248		Hakia	1
	Griffin Area	0		Hovea Area	3
	Halyard	128		North Yardanogo	0
	Harriet Area	349		Perseverance	0
	Helvellyn	0		Senecio	21
	Highgrove	1		Snottygobble	1
	Hurricane	21	Walyering	1	
	John Brookes	1,198	Whicher Range	5	
	Julimar Area	3,816	Woodada	0	
	Kultarr	2	Total	Perth Basin	306
	Lynx	0	Browse Basin (major fields)	Argus	2,120
	Macedon	691		Brecknock	5,618
	Maitland	239		Burnside	1,060
	Martell	530		Calliance	4,134
	Nasutus	21		Concerto	1,060
	Nimblefoot	1,590		Crux	2,650
	NWS Gas Project	20,029		Echuca Shoals	2,332
	Pepper	5		Ichthys	12,890
	Perentie South	11		Ichthys North	1,060
	Pluto/Xena	5,301		Libra	530
	Pyrenees Area	73		Mimia	1,060
	Reindeer Area	538		Posiedon	7,420
Rivoli	159	Prelude		2,650	
Saffron	37	Torsa		5,194	
Scarborough	10,600	Total	Browse Basin	49,778	
South Chervil	7				
Spar	340				
Stybarrow Area	11				
Thebe	3,180				
Thevenard Island	12				
Thringa	0				
Van Gogh	17				
Vincent	21				
Wanaea/Cossack	277				
Wheatstone/lago	9,086				
Total	Carnarvon Basin Total	117,845			